GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

20-page practical manual

GASKETS

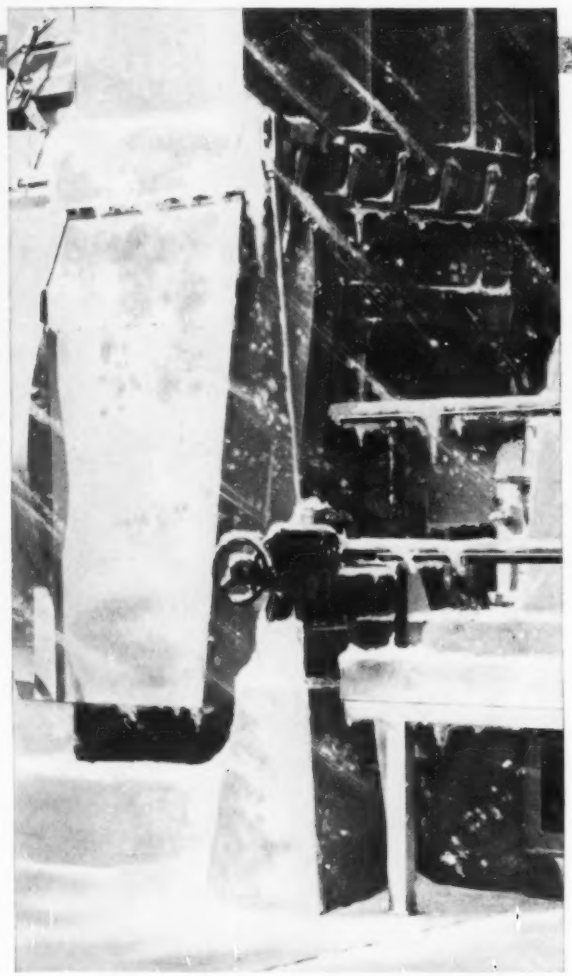
Power

March 1954 • 50¢

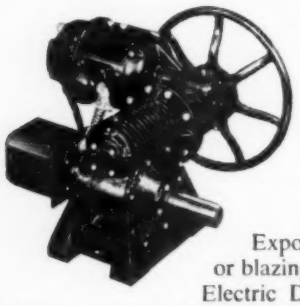
A McGRAW-HILL PUBLICATION

L&N ELECTRIC DRIVE UNITS OPERATE

"weather or not"



This induced-draft fan inlet damper drive unit provides unfailing muscles for L&N Metermax Combustion Control on this outdoor-type plant. Sub-zero temperatures do not affect electric drive unit's operation.



Exposed to ice, sleet or blazing sun, this L&N Electric Drive Unit provides indoor performance on outdoor applications. Because the drive unit is such a vital link in a combustion control system, the weather-free operation of Electric Drive Units is a real advantage for L&N Metermax Combustion Control on outdoor-type plants.

In addition, the L&N Electric Drive Unit provides many more benefits which make it equally valuable for indoor applications. For example:

Indicates true position—small indicating meters on control board show actual drive unit movement, rather than a loading pressure which *should* produce a movement.

Can't be backdriven—self-locking double worm gear does away with additional locking devices.

Transfers instantly—from automatic to remote manual control; there is no intermediate, reset or balancing position required.

Uses auxiliary power—remote control is as reliable as station auxiliary power. The unit releases itself after a service interruption . . . operator does not have to unlock or reset the various units.

Works manually—geared-down handwheel makes manual operation easy.

Write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.

LEEDS & NORTHRUP

Instruments — *Automatic Controls • Furnaces*

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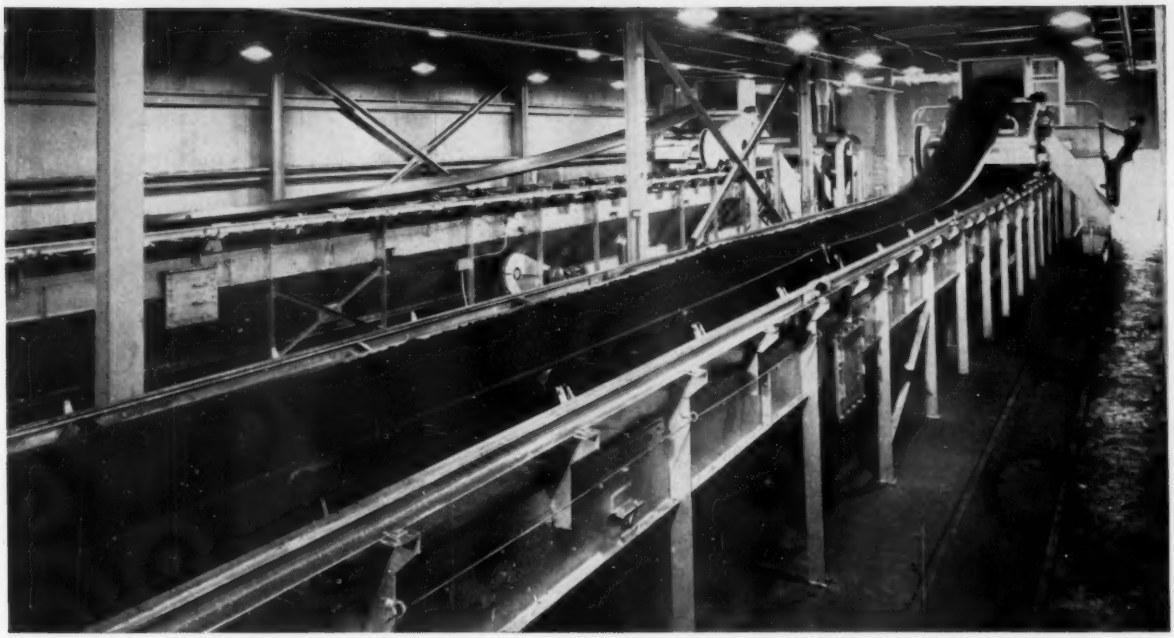
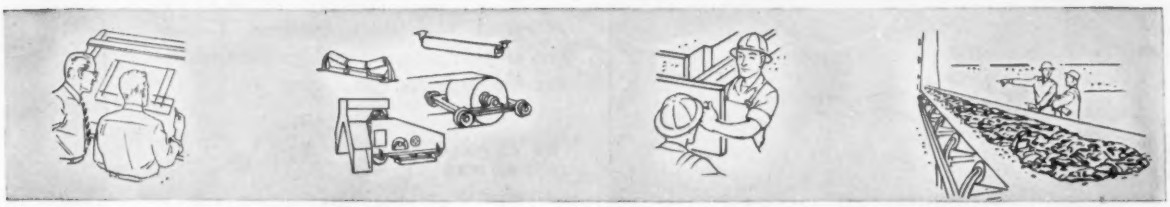
BEAT HIGH TRANSPORTATION COSTS--

carry the load via belt conveyors



Engineered for long-life in coal handling, these twin Link-Belt 36-in. wide belt conveyors employ Series 100 troughing idlers, welded steel pulleys, and self-propelled trippers with bunker seals.

LINK-BELT offers you the "total engineering" so necessary for top efficiency



DESIGNED FOR OVERALL EFFICIENCY

Because of its unrivalled experience, Link-Belt can do a better job of gathering and analyzing all data. Proposals reflect this understanding of the most practical way to fit conveyors into your system requirements.

BUILT FOR LONG-LIFE PERFORMANCE

Link-Belt manufactures all components and related feeders and conveyors. You are assured of the right equipment because of this breadth of line. And Link-Belt will supply the highest grade belts engineered to the job.

DELIVERS FULL RATED CAPACITY

Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews.

ASSURES SATISFACTORY PERFORMANCE

When you rely on Link-Belt as a single source for your complete system, Link-Belt accepts responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems.

Next time you're in the market for one belt conveyor or a complete system, call a conveying expert in the Link-Belt office near you. It's his job to help you get the best in belt conveying at the lowest possible overall cost.

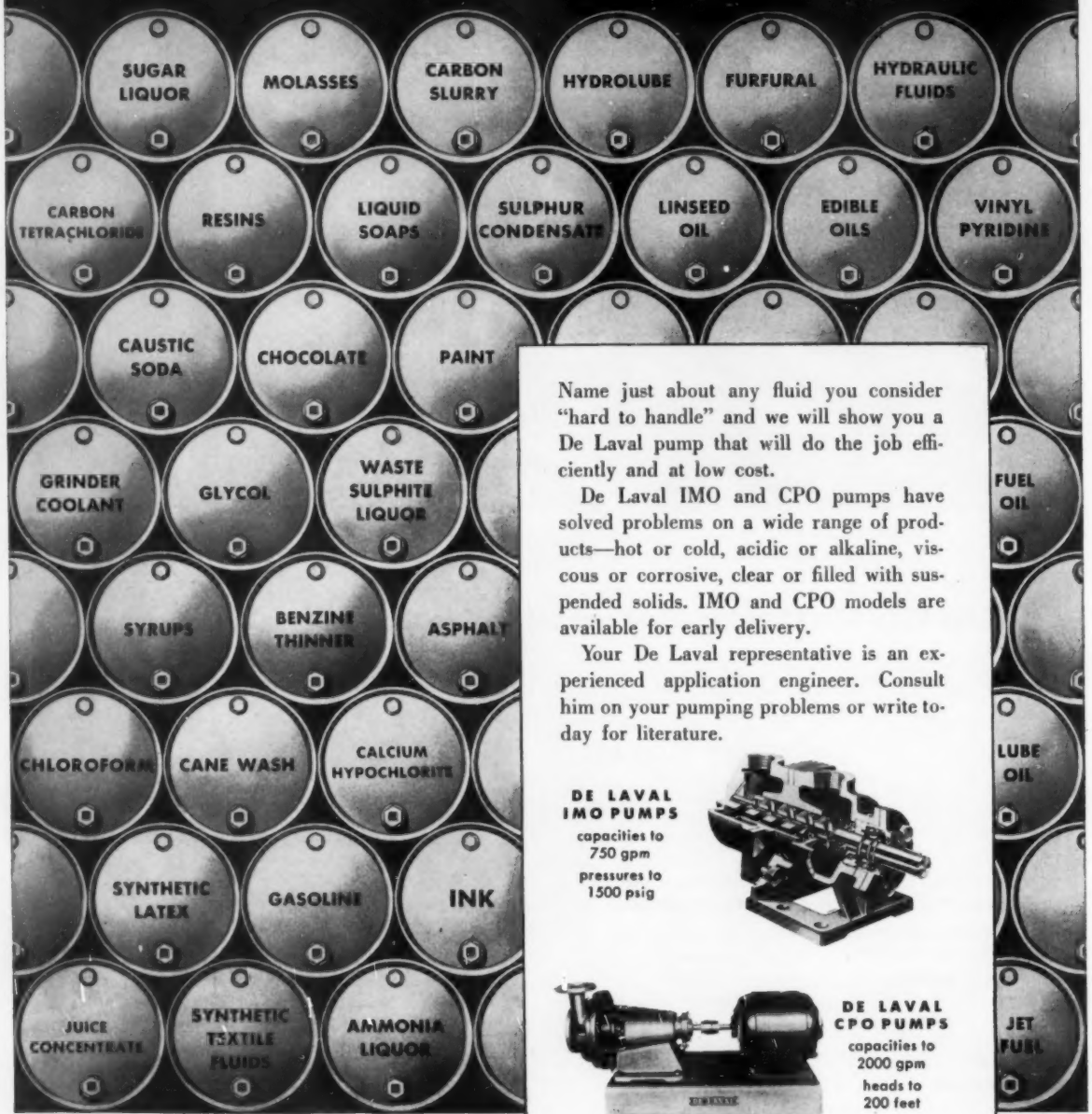
LINK-BELT

BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

13,390-D

Which of these is your pumping problem?



Name just about any fluid you consider "hard to handle" and we will show you a De Laval pump that will do the job efficiently and at low cost.

De Laval IMO and CPO pumps have solved problems on a wide range of products—hot or cold, acidic or alkaline, viscous or corrosive, clear or filled with suspended solids. IMO and CPO models are available for early delivery.

Your De Laval representative is an experienced application engineer. Consult him on your pumping problems or write today for literature.

DE LAVAL IMO PUMPS
capacities to 750 gpm
pressures to 1500 psig

DE LAVAL CPO PUMPS
capacities to 2000 gpm
heads to 200 feet

DE LAVAL *Pumps*

DE LAVAL STEAM TURBINE COMPANY
815 Nottingham Way, Trenton 2, New Jersey

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Power

MARCH 1954 • VOLUME 98 NUMBER 3

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GASKETS have a single lifelong objective—keeping fluids in place. To do this job better, new materials and techniques are entering the field—a field where ultimate success, measured in terms of leak-stopping, can mean billions of dollars yearly to American industry. This staggering potential, with all it means to POWER readers, prompted our 20-page manual (pp 105-124).

During the organizing and rough-draft stage of this new addition to POWER's long list of special features, Steve Elonka, its author, was literally surrounded with gaskets of many different materials and shapes. Some found their way as models into artist Kent Day Coes' bailiwick in McGraw-Hill's illustration dept. Incidentally, that red is the real McCoy—makers of spiral-wound gaskets paint the retaining ring to prevent rusting. With this bright start, Coes went to work. The result: This month's cover.

Next month . . .

■ You'll agree plant operation is safer, and less costly, in the hands of one good man than it is when divided amongst many—especially when the going gets tough. And with modern centralized control, one man can be selected. It's but a short step from this sort of thinking to the main ingredients in Western Electric's power plant revamping: Built-in safeguards against human failures.

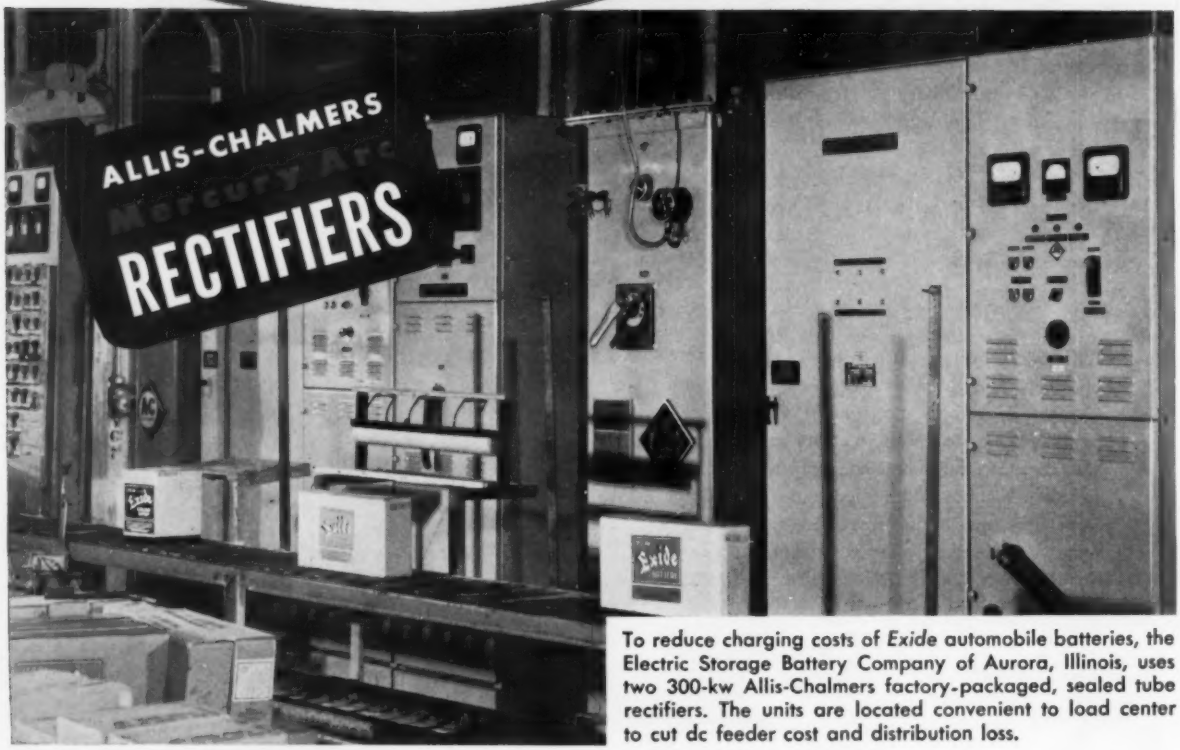
■ Industry's electric bills are all too often taken for granted as stemming from a thoroughly inflexible rate structure. 'T aint so. Better understanding of the *how* of electric rates, as brought out in an April article, can mean real dollar savings in many plants.

■ With newspapers heralding the "era of direct conversion of atomic energy into electric current" by way of the strontium battery, questions are popping into ninds of power men, stimulated to no small degree by the wondering layman. The real significance of this development is must reading—next month.

. . . and future months

■ If you feel you're well acquainted with what photography can do to aid plant operation, watch for an upcoming article on how Detroit Edison uses the camera. In addition to doing a bang-up job on the familiar forms of photography, they've got some new slants you'll want to look into for your plant.

Low Cost *Installation*



To reduce charging costs of *Exide* automobile batteries, the Electric Storage Battery Company of Aurora, Illinois, uses two 300-kw Allis-Chalmers factory-packaged, sealed tube rectifiers. The units are located convenient to load center to cut dc feeder cost and distribution loss.

FACTORY-PACKAGED RECTIFIER UNITS CUT INSTALLATION TIME AND COSTS

The factory-packaged design of Allis-Chalmers sealed tube mercury arc rectifiers has all component parts metal enclosed and integrally connected in one compact unit to cut labor time and costs . . . only connection to power and control leads and to cooling water supply is necessary to make unit ready for service. Because of their light weight, the rectifiers can be installed on a balcony or elsewhere, close to load centers to minimize direct-current feeder cost and reduce distribution loss . . . requires no special foundation.

Allis-Chalmers sealed tube rectifiers are offered in ratings from 220 kw at 250 volts to 1000 kw at 600 volts.

When you are planning new direct-current power installations of *any* size, compare the many cost cutting features of Allis-Chalmers mercury arc rectifiers. For complete details and engineering help, call your nearest A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

Power

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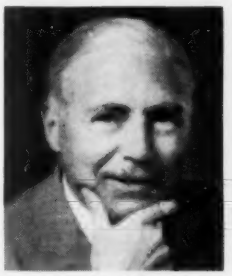
If you have completed a modernization job during 1952 or 1953, here is your opportunity for recognition. Renovation may be of your entire power-service system or any major part—either in the powerhouse or out in the plant.

Through the pages of POWER, results obtained in selected plants will be made known to fellow engineers across the country. And plants chosen for outstanding accomplishments will receive a citation testifying to that fact—to be proudly displayed for all to see.

Entries may be made for any type plant—steam, diesel or hydro—in any service—industry, institution or utility. To get an entry blank simply drop a note to Modernization Awards, POWER, 330 W. 42nd St., New York 36, N. Y.

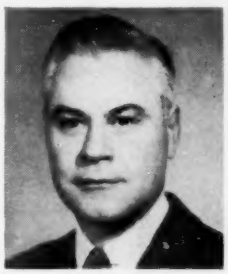
...lines and bylines



Ross Nebolsine

ENGINEERING the water supply and waste treatment in U.S. Steel's huge Fairless Works (p 69) called for, and got, topnotch talent. With a combined background that ranges from developing water sources for a 20,000-acre sugar plantation in Peru to rehabilitating a Youngstown, Ohio water-purifying plant, three of Hydrotechnic Corp's key men tackled the Morrisville, Pa. project.

Top man in this smooth-working team is President Ross Nebolsine, backed up by A D Henderson, vice-president and general manager, plus Chief Engineer Hugh MacDougall. Nebolsine, a stickler for designing with service continuity uppermost in mind, saw to it that sufficient water will always be available at Fairless. So, even in emergencies, there will be at least minimum steel-plant operation to prevent damage to mill equipment.

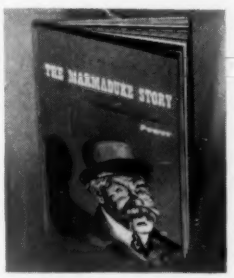


John M Bandel

VICE-PRESIDENCY of Electro Metallurgical Co came for J M Bandel just 20 years after receiving an ME degree from Johns Hopkins University. After graduation he spent several years in the field before going with Electromet in 1941 as development engineer. Then Bandel quickly forged through the research department, helped in construction of the company's Spokane plant, carried major responsibilities for design and construction of new power plants in Ashtabula and Marietta, Ohio (see page 86).

Initiator of the Marietta project was E H Mangan, then vice-president of Electromet (a division of Union Carbide and Carbon). He continued to follow the plant's development with close interest after becoming executive v-p in 1952.

A 1913 MIT graduate, Mangan started with Electromet in drafting, moved up through works engineering to become asst supt of the Alloy, W. Va., plant in 1941, and then went on to executive posts.

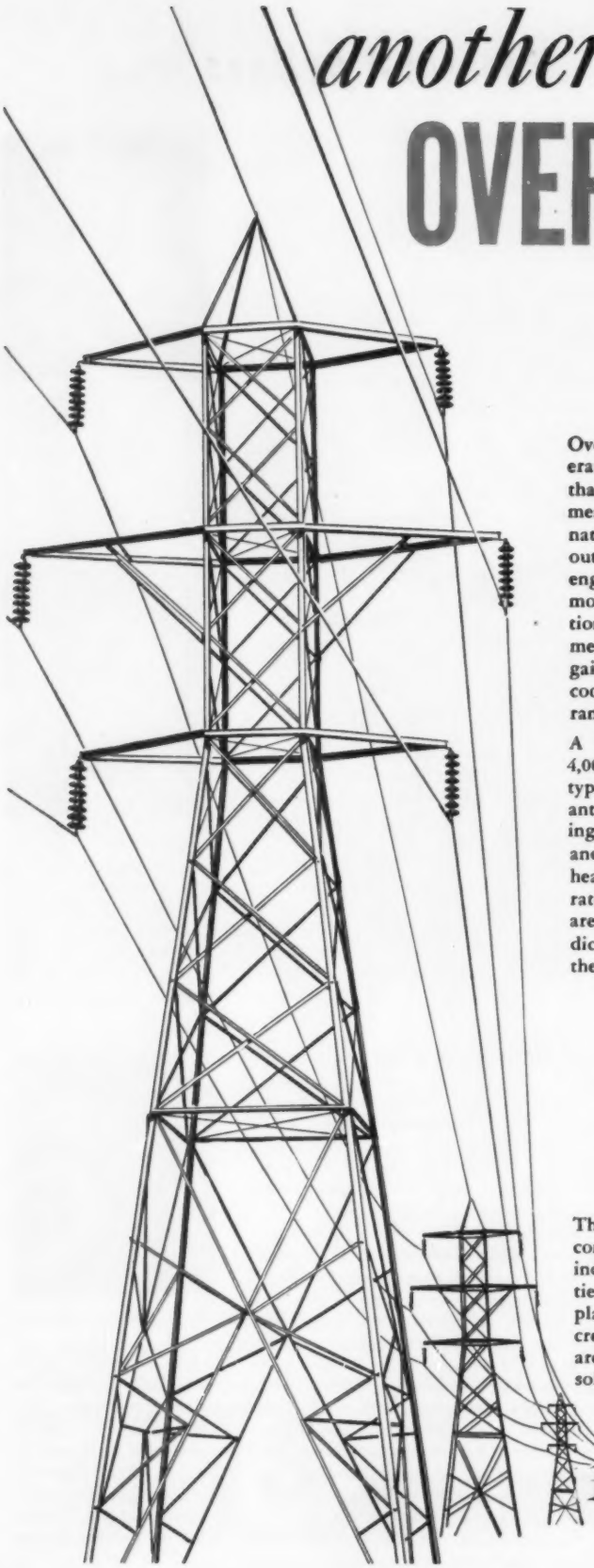


20 of Marmy's best!

"THE MARMADUKE STORY" will bring many a chuckle to power men, and others too, as they read the ageless yarnmaster's shrewd philosophical outpourings, now in book form. Some 20 of Marmy's choicest tales from POWER are contained in a hard-covered book, now offered to readers for $1 a copy.

Marmaduke's discoverer, and month-to-month author-guardian, is the same Steve Elonka who whipped up the 20-p practical manual on gaskets in this issue, p 105. We who work alongside Steve are quite familiar with the gasket-blowing that goes on when Marmy storms through his monthly tales. So we weren't too surprised when Steve selected the same subject, but in a serious professional vein, for his current practical manual.

Readers have known Steve since 1947 as the editor-author of a spiraling number of hard-hitting articles on plant operation and maintenance, plus his widely read "Operators Notebook," "How to," and "Practical Ideas." Blessed with a rich 14-year background as machinist, trade-school teacher and naval officer, Steve has developed into a prolific writer with a keen sense for tracking-down articles, an invaluable part of every successful working editor's makeup.



another great record

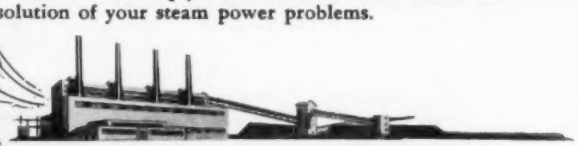
OVER 9,000,000 ON THE

Over nine million kilowatts of new thermal and hydro-generating capacity put on the line during 1953, again offers proof that America's power companies are fully aware of their tremendous responsibility for the growth and progress of this nation. The continuing program of expansion being carried out is a monument to the foresight of power executives and engineers. The astonishing strides they have made toward more efficient utilization of fuel, and the rapid implementation of new engineering developments for universal benefit, mean that electricity will continue to be America's Best Bargain. Their achievements represent many decades of prodigious, cooperative work; of sound preliminary planning and long range vision.

A considerable portion of this new capacity—well over 4,000,000 KW . . . is being generated by B&W Boilers of all types put in service during 1953. Represented are B&W Radiant, Stirling, Open Pass, and Integral-Furnace Units, embodying every major advance in the science of modern combustion and steam generation. Cyclone Furnaces, Pressure Firing, Reheat, Divided Furnace Construction, and Cyclone Steam Separators, all proved by years of intensive operating experience, are included in these units—singly or in combination, as indicated by individual circumstances and conditions—to effect the greatest possible generating economies:

- Thirteen of these units are for design pressures over 2000 psi—all with Cyclone Steam Separators for natural circulation
- Four are Cyclone-Furnace-Fired
- Nineteen are for Pressurized-Furnace-Firing
- Eighteen—including the largest units of their kind—are equipped with reheaters
- Twenty have B&W's simple Divided Furnace construction for maximum savings in building volume

The experience and advanced technology reflected in B&W's contribution to this huge volume of new capacity is a good indication of the confidence placed in B&W by electric utilities at home and abroad . . . confidence based on the sound platform of past experience. B&W's wealth of research and creative engineering talent, its broad and diversified facilities, are available to help you find the most efficient and economical solution of your steam power problems.



set by America's Utilities
KW OF NEW CAPACITY LINE IN 1953

ONE OR MORE
B&W BOILERS WERE PLACED
IN SERVICE FOR THE FOLLOWING UTILITIES IN 1953

Appalachian Elec. Power Co.
Braintree Electric Light Dept.
Central Louisiana Electric
City of Burbank, California
City Electric Light Company, Brisbane, Australia
City of Glendale, California
City Public Service Board, San Antonio, Texas
Commonwealth Edison Co.
Consolidated Gas Elec. Lt. & Pr. Co. of Baltimore
Consolidated Edison Co. of N. Y., Inc.
Consumers Power Co.
Dallas Power & Light Co.
Detroit Edison Co.
Duquesne Light Co.
Electricite de France
Florida Power Corp.
Gulf Power Co.
Houston Lighting & Power Co.
Indianapolis Power & Light Co.
Iowa Public Service Co.
Iowa-Southern Utilities Co.
Isefjord Power Co.
Jersey Central Power & Light
Kentucky Utilities Co.
Kingdom of Greece
Mississippi Power Co.
Niagara-Mohawk Power Corp.
Ohio Edison Co.
The Ohio Power Co.
Oklahoma Gas & Electric Co.
Philadelphia Electric Co.
Public Service Co. of Colorado
Public Service Company of New Mexico
Public Service Div. of Commonwealth Edison Co.
Soc. Gen. Elec. Della Sicilia
Societa Idroelittrica Peimonte
Societa Meridonale de Electricita
Tampa Electric Co.
Tennessee Valley Authority
Tucson Gas Elec. Lt. & Power Co.
United Illuminating Co.
West Texas Utilities Co.
Wisconsin Power & Light Co.

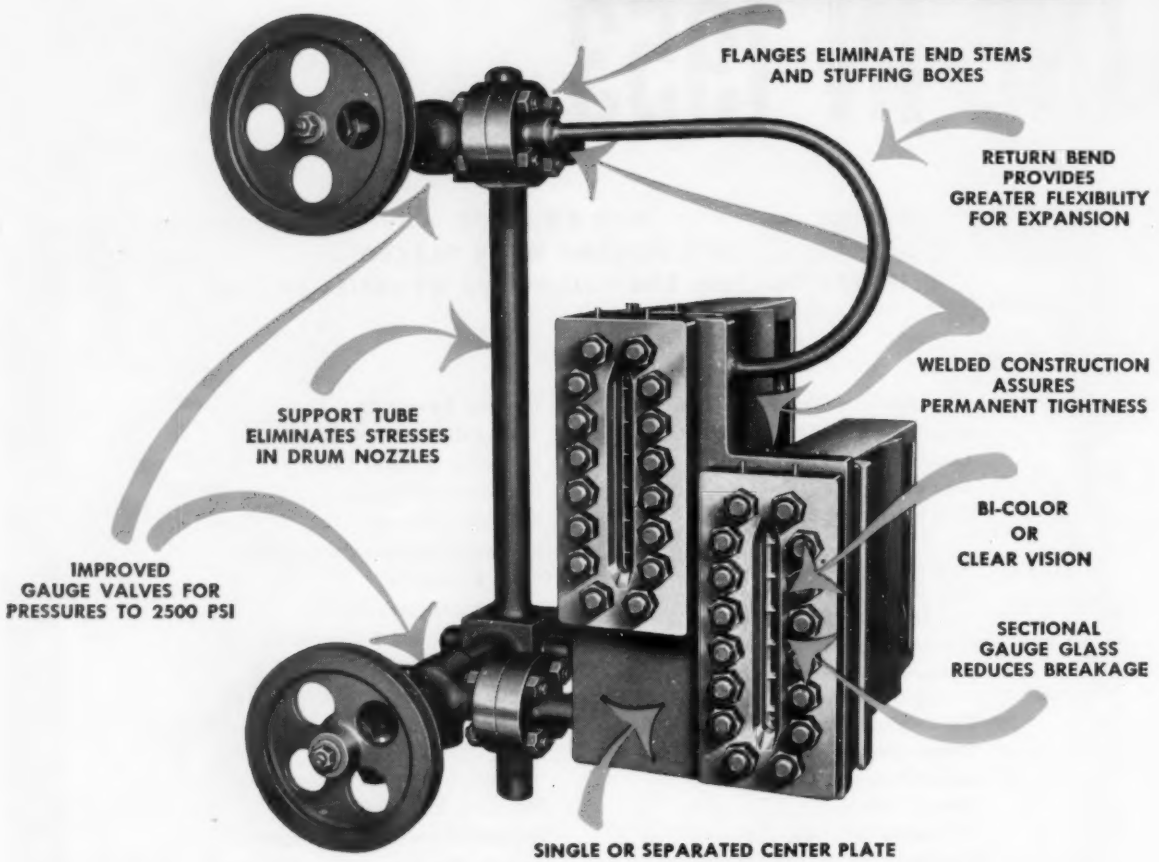
The Babcock & Wilcox Company, Boiler Division
161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX
BOILER DIVISION

G-635

DIAMOND Flange Connected WATER GAUGES

The Answer to High Pressure Gauge Problems


FLANGES ELIMINATE END STEMS AND STUFFING BOXES
RETURN BEND PROVIDES GREATER FLEXIBILITY FOR EXPANSION
WELDED CONSTRUCTION ASSURES PERMANENT TIGHTNESS
SUPPORT TUBE ELIMINATES STRESSES IN DRUM NOZZLES
BI-COLOR OR CLEAR VISION
IMPROVED GAUGE VALVES FOR PRESSURES TO 2500 PSI
SECTIONAL GAUGE GLASS REDUCES BREAKAGE
SINGLE OR SEPARATED CENTER PLATE

As can be seen in the illustration, this different engineering approach solves three major problems in high pressure water gauges . . . tightness . . . expansion and stress . . . and glass breakage. Additional important advantages are maximum level visibility with minimum nozzle spacing . . . and more accurate reading.

The uninsulated bend provides sufficient condensing area to assure active circulation of hot condensate through the gauge. This maintains the gauge at higher temperature so there is less difference between boiler water and gauge water density. That and the shorter gauge assure greater accuracy.

These gauges are available in either Bi-Color or clear vision construction. Ask for Bulletin No. 1051U, Diamond Water Gauges and Water Columns.

6545

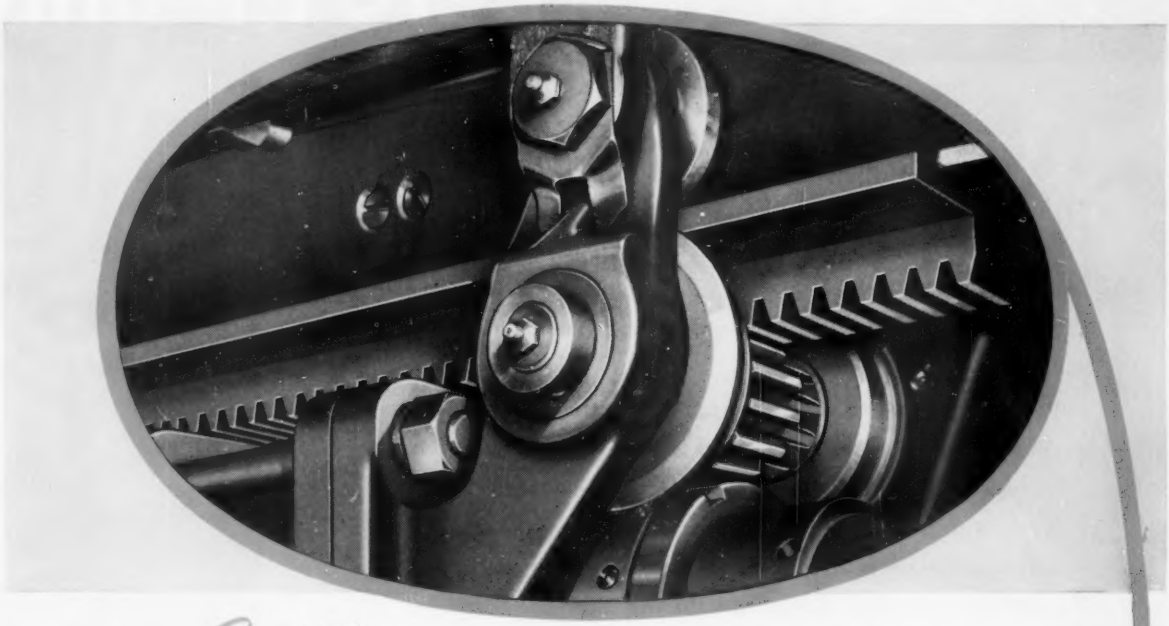
DIAMOND POWER SPECIALTY CORPORATION

50th ANNIVERSARY 1903-1953

LANCASTER, OHIO

Diamond Specialty Limited — Windsor, Ontario

POSITIVE GEAR DRIVE



Another Reason

for the **SUPERIOR PERFORMANCE** of DIAMOND Model IK LONG TRAVEL RETRACTING BLOWERS

The lance tube of the Diamond Model IK Long Retracting Blower is propelled into the furnace by the carriage which is driven by a rugged pinion gear which engages a heavy rack. Gearing will stall lance in event of motor drive failure during blowing. This represents the ultimate in safety and reliability.

This is only one of several reasons for the superior performance of the Model IK. Others are the single motor drive (one motor simultaneously propels the carriage and rotates the lance) . . . mechanically operated poppet valve which provides simple, positive and accurate control of blowing medium (air or steam) . . . integral adjustable pressure control.

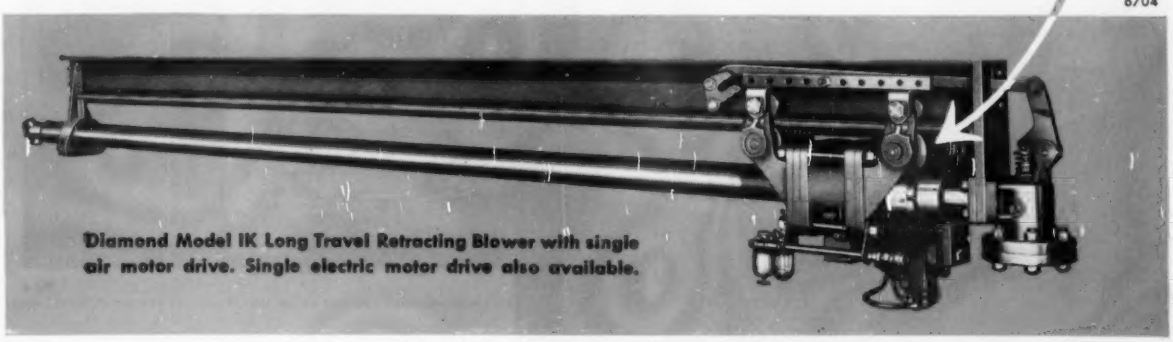
Advanced engineering features such as these, plus reliability proved over the years, are important reasons why the great majority of engineers prefer Diamond Blowers.

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

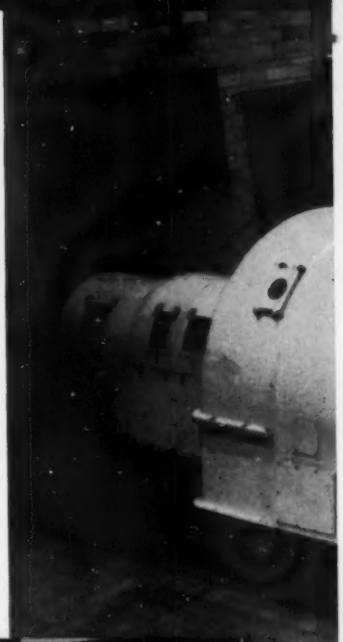
Diamond Specialty Limited • Windsor, Ontario

6704

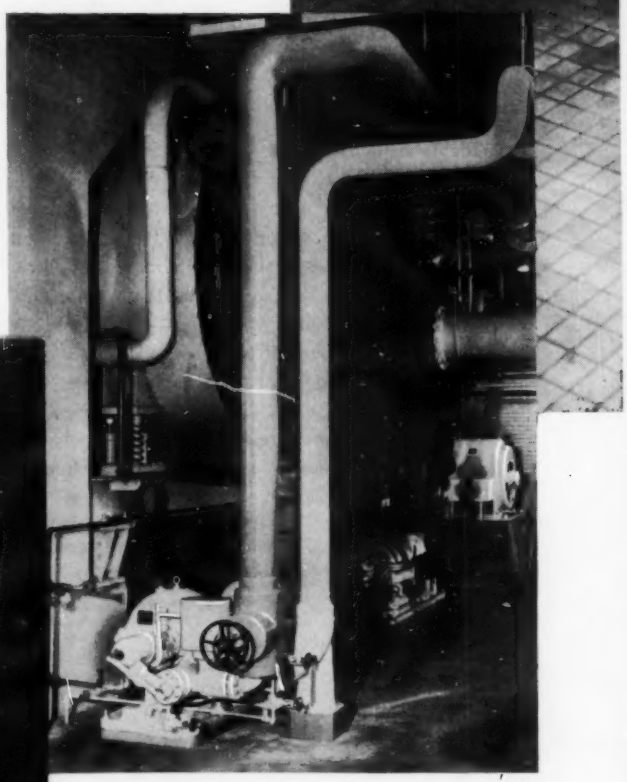


Diamond Model IK Long Travel Retracting Blower with single air motor drive. Single electric motor drive also available.

The *sixth* ELLIOTT unit

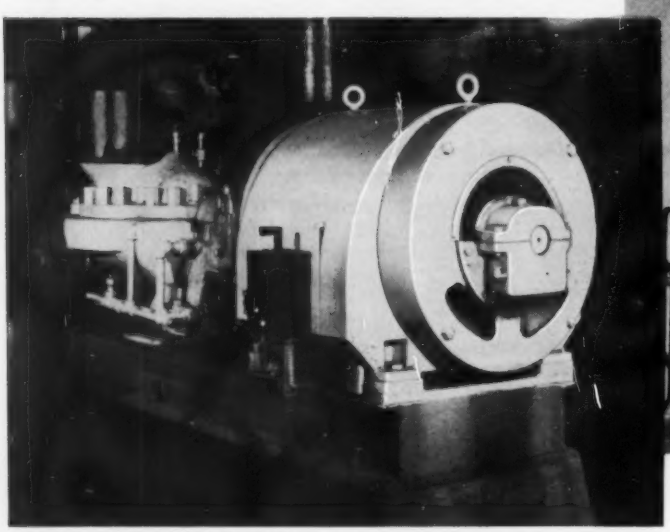


• Called a model plant, the Piqua, Ohio, utility has since its inception installed a succession of Elliott turbine-generator units. In 1933 two 4000-kw units started operation. Growing power demand brought the addition of another 4000-kw Elliott unit in 1939. Further expansion in 1946 saw the installation of a 7500-kw condensing turbine-generator and a 1000-kw noncondensing unit supplying process steam to an 8-in. distribution line. But Piqua continues to thrive and grow, dictating the recent installation of their largest unit, a 10,000-kw Elliott turbine-generator unit. Besides the turbine-generators, other major and auxiliary equipment in the Piqua plant is also Elliott, making the plant one in which Elliott Company feels a deep and abiding interest.



One end of the Elliott 12,000-sq ft divided water-box surface condenser which serves the new 10,000-kw turbine. In the immediate foreground, an Elliott 25-hp turbine, and in the middle distance, an Elliott 25-hp motor, both driving condensate pumps. In the background, an Elliott 200-hp motor driving an induced-draft fan.

Close-up of an Elliott 200-hp, 3600-rpm motor driving a boiler-feed pump.



H3-4

for Piqua, Ohio

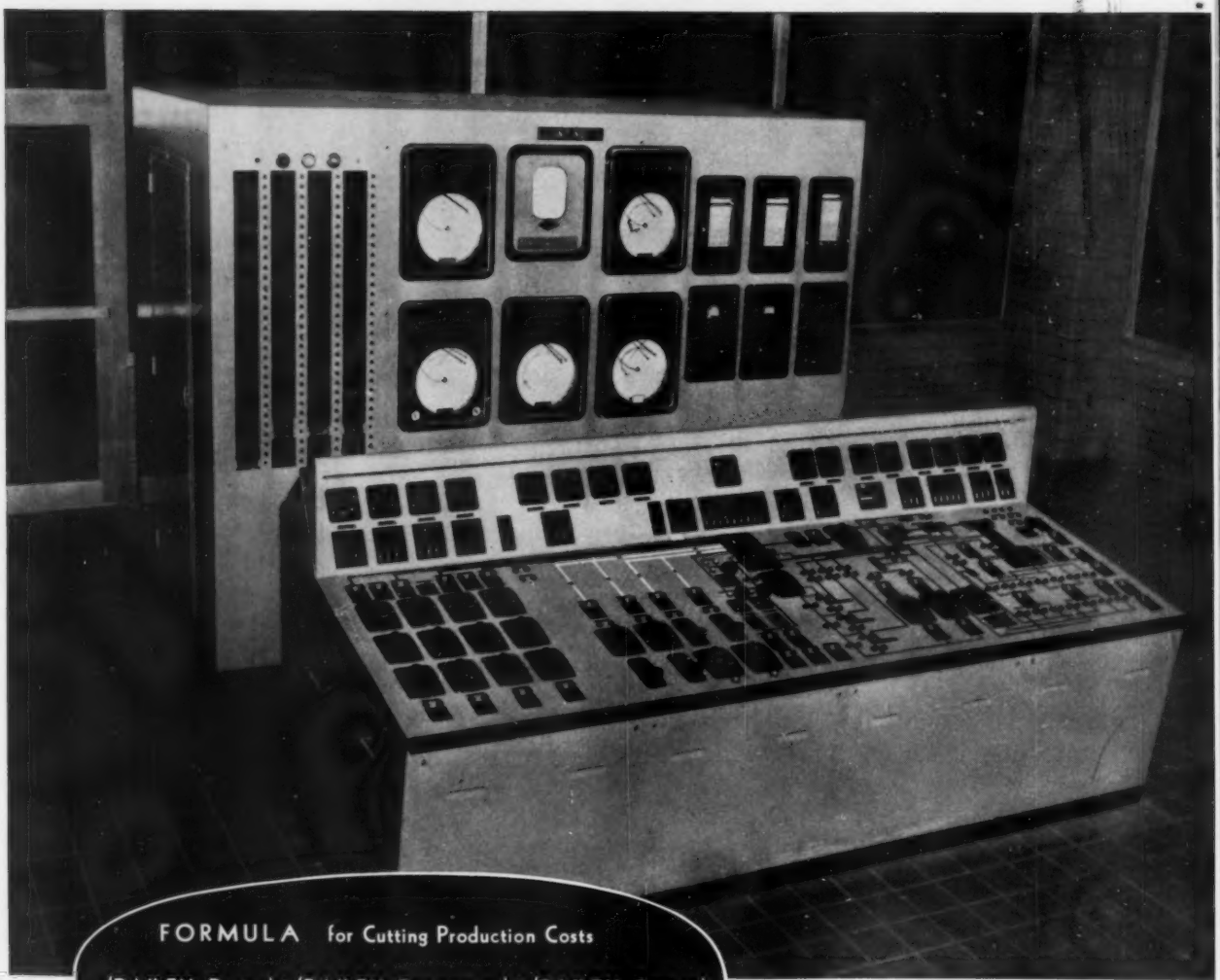
THE BIG PARADE of Elliott turbine-generators at Piqua, began in 1933 with the two units in the far background of the above photo, continued through several more installations, and is brought up to date with the recent addition of the 10,000-kw turbine-generator unit in the immediate foreground.

For complete details on Elliott turbine-generators, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

How to Increase the Return on



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Center for 60,000 kw reheat boiler-turbine Unit No. 1 at Danskammer Point Steam Station of Central Hudson Gas & Electric Corp. Bailey MINI-LINE Equipment on benchboard gives operators fingertip control while larger recorders on vertical board show operating trends and make permanent records. Duplicate Bailey Equipment has been purchased for Unit No. 2.

Engineering and construction by Burns and Roe, Inc.

Your Boiler Room Investment

★ There are four important ways to increase the return on your Boiler Room Investment:

More power per fuel dollar
Less outage
Delivery of steam at design conditions
Greater operating safety

None of these items taken alone will produce the highest return—it takes all four working in close harmony.

That's where co-ordinated controls by Bailey Meter Company help. And here is why Bailey Controls are your best choice:

1. Complete Range of Equipment—fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you. Bailey Meter Company's Sales-Service Engineers are located in more Industrial Centers than those of any other manufacturer of Boiler Control Systems; you get prompt, experienced service with a minimum of travel-time and expense.

For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage, steam at design conditions, and greater operating safety—you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-115-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

New COPES TYPE
OFFERS A CHOICE OF

With Instrumentation by Taylor

From the oldest comes the newest in three-influence feed water control—Copes Type 3-L with instrumentation by Taylor. A minimum of instruments are required due to simplicity. Miniature recorders are indicated at the right. Standard size recorders may also be used to supply up to four records on one chart. Each component of the Type 3-L system is selected for its accuracy and high quality. Each installation is backed by nation-wide service, whenever or wherever required, for its entire life.

Without Recording Instruments

To further simplify a 3-L system, recorders may be omitted. The schematic at lower right is the simplest instrument-type Copes three-influence feed water control system that is available. Ask for Bulletin 1013-A which describes the combinations available in Type 3-L feed regulation.

Copes three-influence control may also be actuated mechanically or electronically.

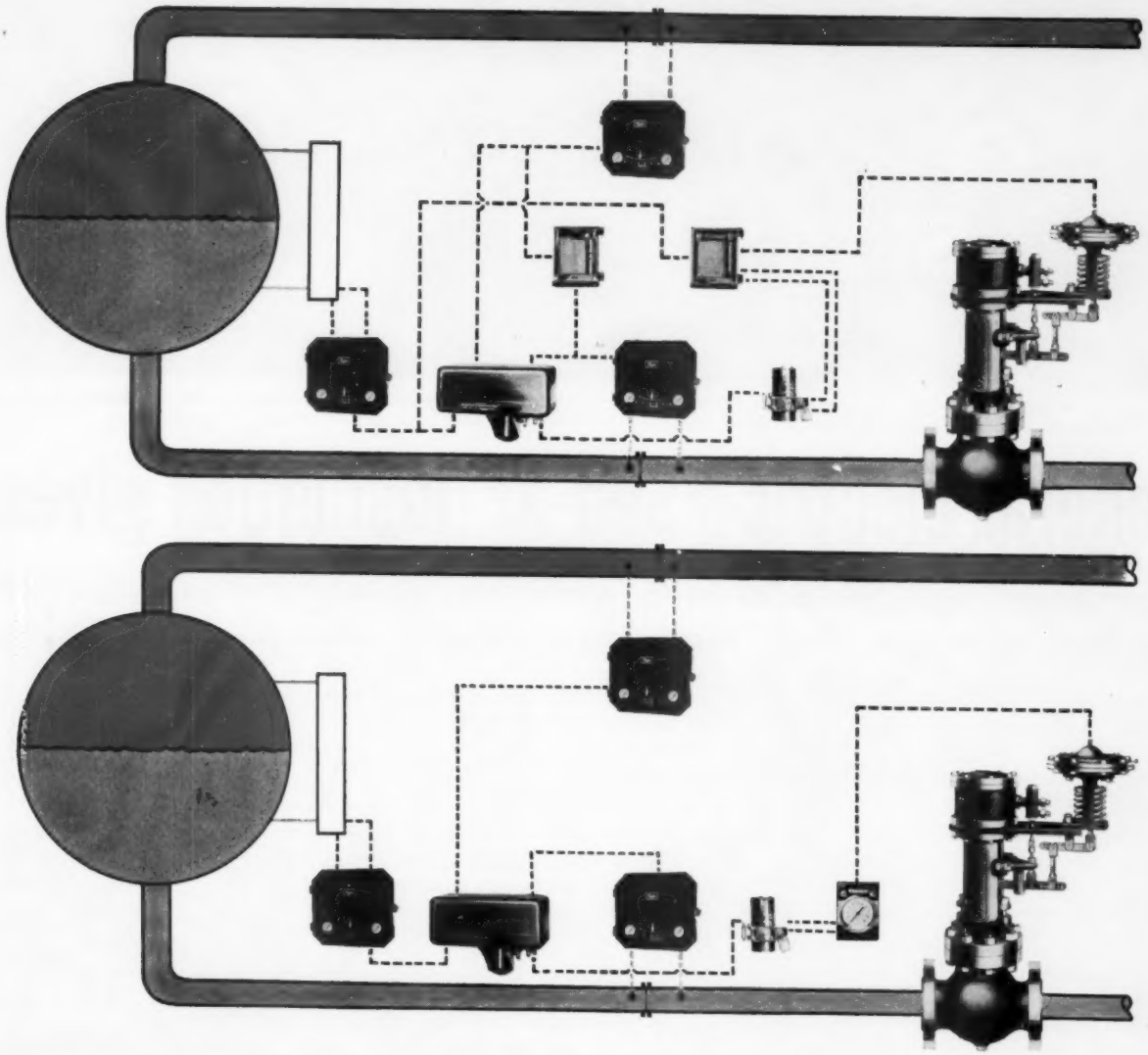
COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

FIRST TO DEVELOP CONTINUOUS

BOILER FEED

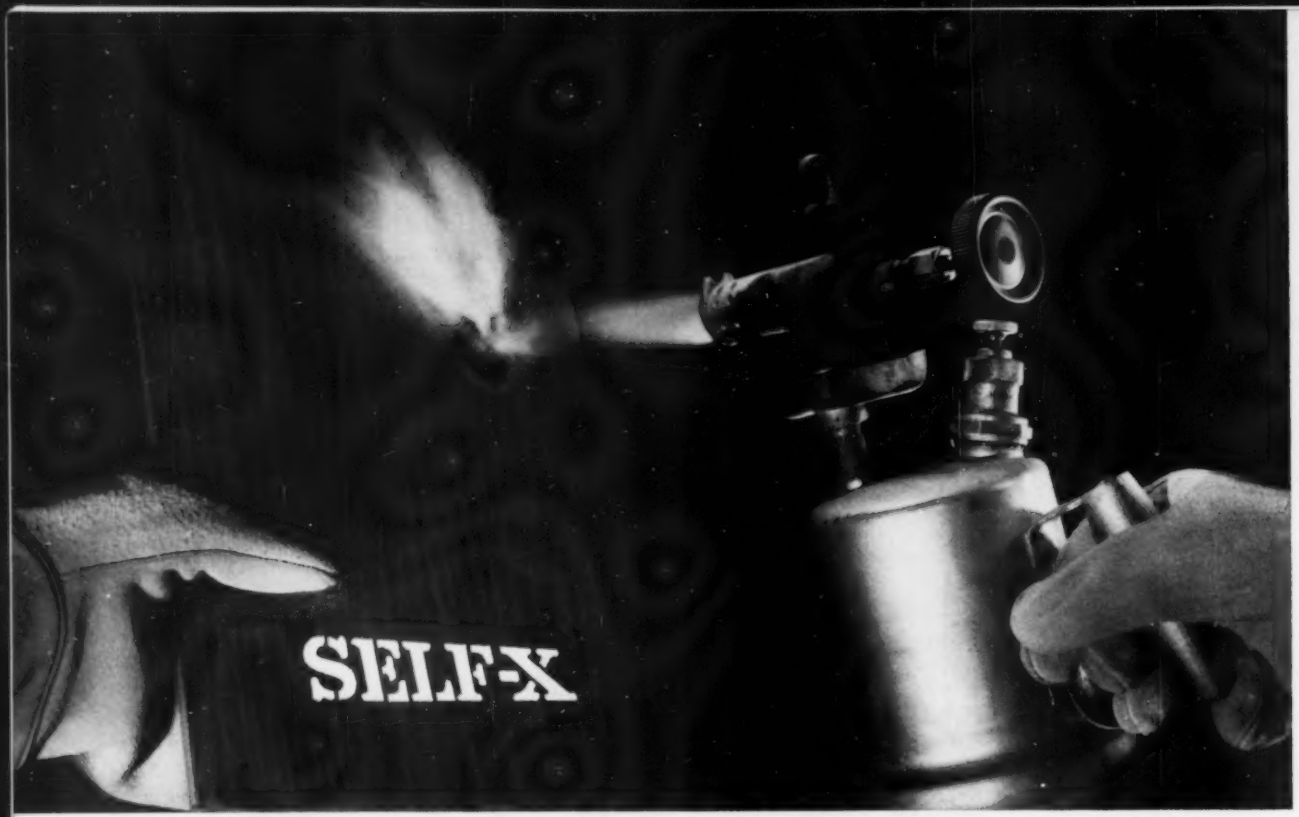
3-L SYSTEM

3-INFLUENCE CONTROLS



BOILER FEEDING UNDER AUTOMATIC CONTROL

WATER REGULATION



ONLY UNDER DIRECT FLAME, will GE's new self-extinguishing insulation for metal-clad switchgear char—as demonstrated in this picture with flame of blow-torch applied directly to the new laminated sheet-type insulation.

General Electric "Self-X" insulation gives

New sheet-type material with exclusive, flame-retardant feature localizes damage that may occur under abnormal conditions

The equivalent of a "built-in fire extinguisher"—a flame-retardant insulation for switchgear, marks the most recent General Electric development for even safer, more dependable metal-clad switchgear—industry's standard for 2400- to 13,800-volt circuits.

In introducing this flame-retardant insulation—which was perfected by Nicholas F. Arone, engineer in its Switchgear Department in Philadelphia—G.E. has gone far to minimize all potential fire hazards in switchgear.

All good insulating material has three standard properties: high mechanical strength, high dielectric strength, and a non-hygroscopic quality. To this group, G.E. is the first to add an important fourth property: a self-extinguishing characteristic that *refuses to sustain combustion.*

The laminated insulation sheet will burn and char—but *only* if an outside source of flame remains in contact with the sheet itself. Once the source is removed, polyvinylchlorides "smother" the flame in less than a minute—localize damage—and permit quick access to compartments for inspection and maintenance.

In bus and cable supports, in insulating barriers between compartments, in box barriers for arc chutes—throughout vital spots of metal-clad, GE's new flame-retardant insulation works for greater protection under *all* conditions—without extra cost to you.

For information on improved Metal-Clad Switchgear, with new, flame-retardant insulation, call your nearest G-E sales representative, or write to General Electric Company, Schenectady 5, N. Y. 874-3

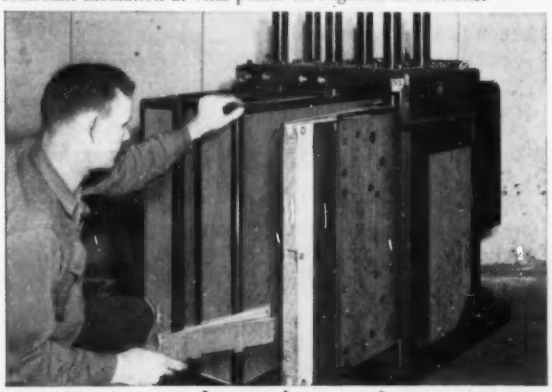
G. E. BURENS, *general manager, Switchgear and Contro' Division, presents Coffin Award to N. F. Arone for development of outstanding new insulation. Coffin Award is General Electric's highest employee honor.*

GENERAL ELECTRIC

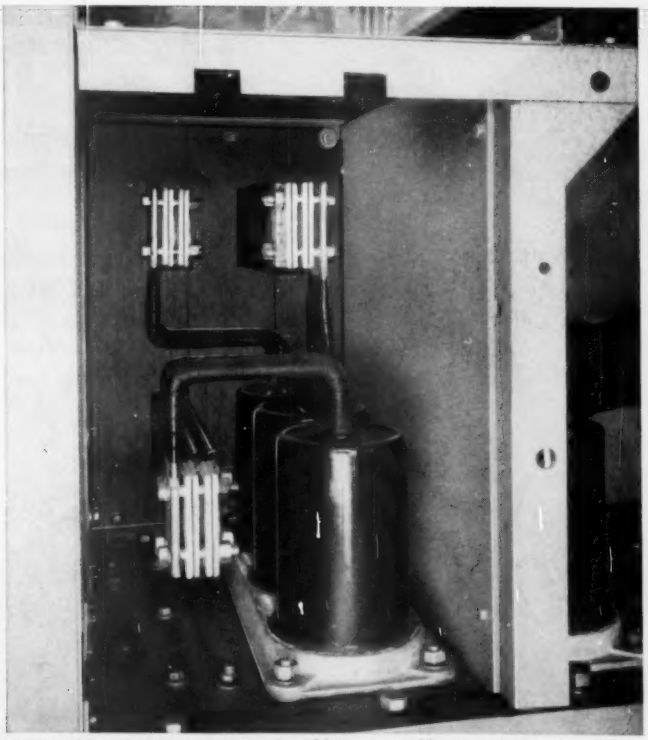
WITH FLAME REMOVED, the flame-retardant insulation refuses to sustain combustion—and extinguishes itself in less than 60 seconds. Polyvinyl-chlorides in the laminated sheet "smother" the flame, permitting ready access to compartments for inspection and maintenance.

added protection to metal-clad switchgear

THIS METAL-CLAD SWITCHGEAR lineup features GE's new flame-retardant insulation at vital points throughout all sections.



INSULATING BARRIERS for arc chutes are flame-retardant, non-hygroscopic, possess high mechanical and dielectric strength.



COMPARTMENTIZED SECTIONS, in addition to self-extinguishing insulation as shown in this bus section, limit damage from abnormal conditions.

LOOK WHAT'S HAPPENING TO BOILER WATER GAGES.

● There's a "new look" in water gages for high pressure boilers. You'll find it in every new YARWAY Flat Glass Boiler Water Level Gage.

YARWAY design and development engineers have made *twelve distinctive improvements* in YARWAY gages. All contribute to improved water gage service, longer water gage life.

Better Illumination—improved mercury vapor illumination makes meniscus "shine like a star".

Body Improvements—flanged connections and expansion bends eliminate stuffing boxes and *prevent distortion*—separated design in four-glass inserts permit freedom for expansion—stainless steel facing for gasket recess provides corrosion proof surface for the higher pressures—close machining tolerances insure top quality.

Improved Gaskets and Mica—"Frelon" gaskets are coated with a special compound to prevent sticking at disassembly—wire inserts for the higher pressures give "Frelon" gaskets greater strength—thicker mica for the higher pressure gages.

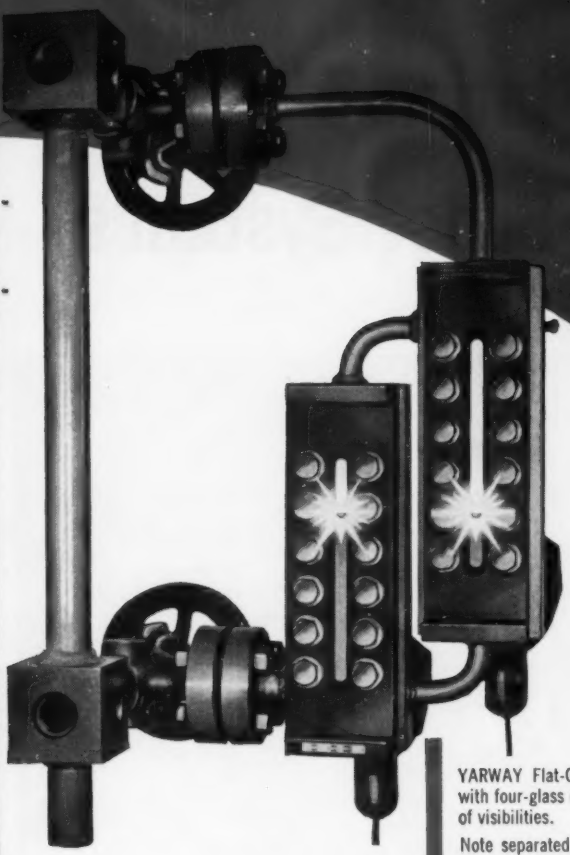
"Floating Assembly" Covers—improved capscrews have wider shoulders at face of body—improved spring cones reduce spring cone stresses.

Better Valves—YARWAY Welbond gage valves have integral stellite seats and stainless steel stems—Welbond water column shut-off valves have lock-open device.

YARWAY Gages are the "gages to see" on all new boiler units or replacements in high-pressure installations.

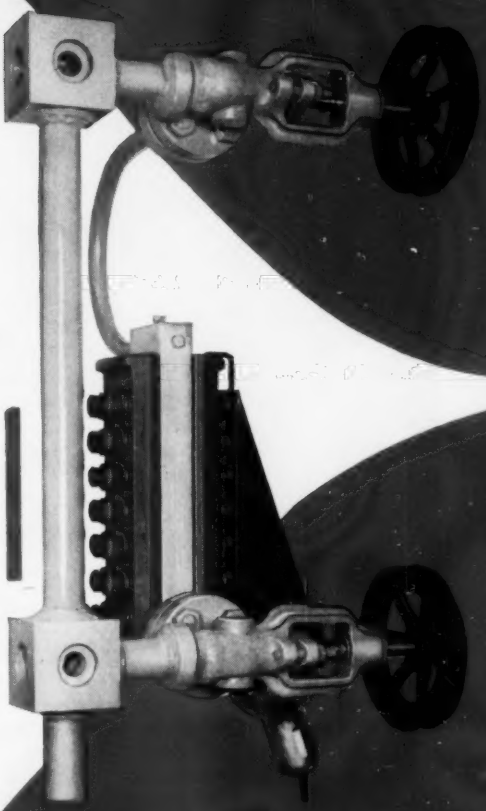
Write now for new YARWAY Bulletin WG-1812.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

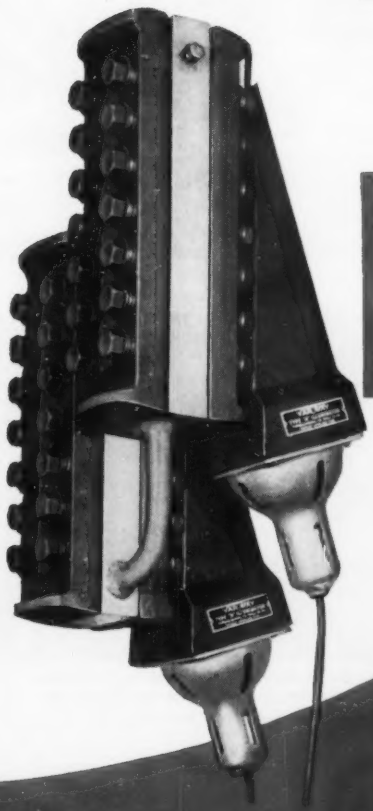


YARWAY Flat-Glass Water Gage Assembly with four-glass double insert for long ranges of visibilities.

Note separated design, interconnecting expansion loops, flanged connections (1½" tie-bar-type circulating water column) and Type "M" Illuminators that make meniscus at water level "shine like a star".



YARWAY Single Insert type gage for medium range of visibilities. Note expansion loop and flanged connections. YARWAY Welbond Gage Valves assure highest dependability in high-pressure service.

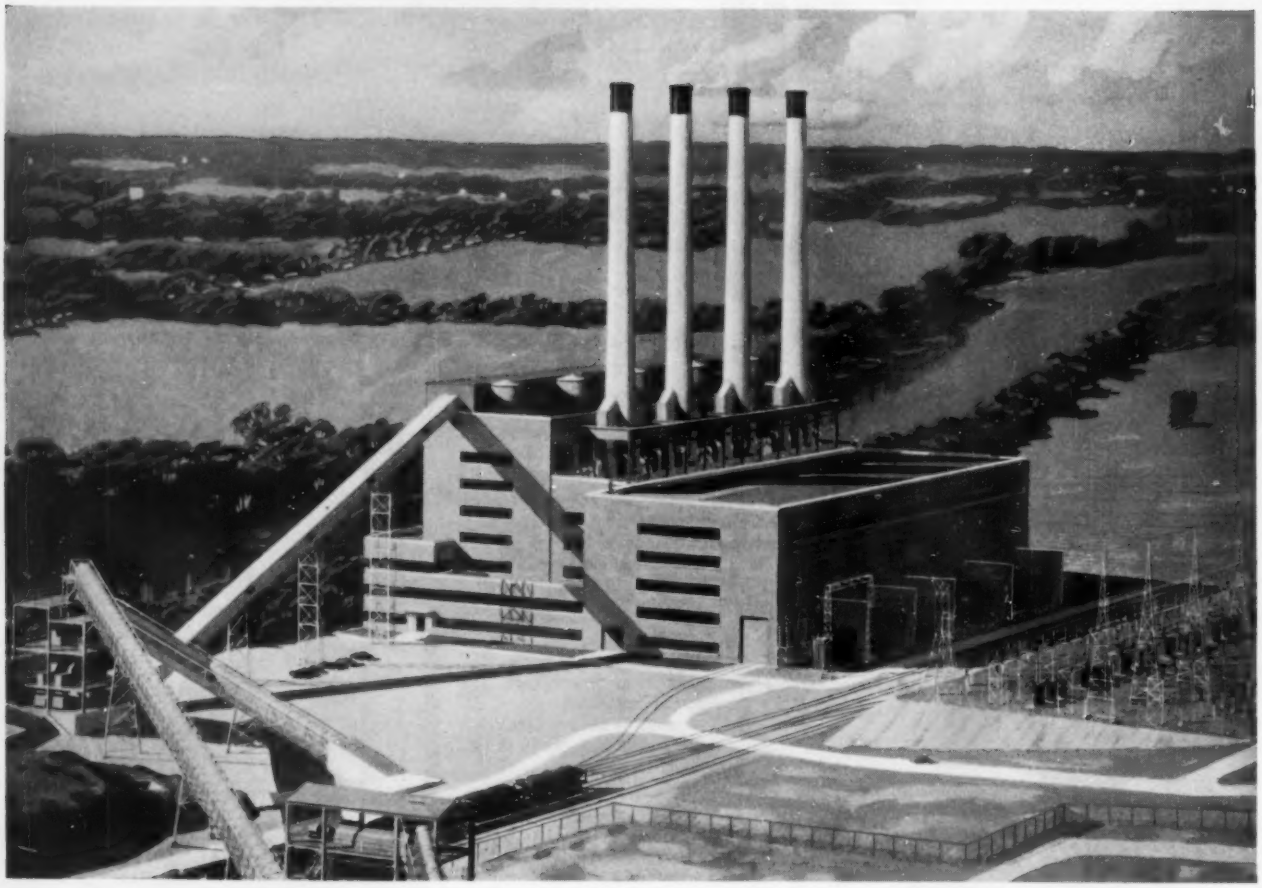


Close-up of YARWAY Type "M" Illuminators on above 4-glass insert assembly. The blue-white illumination is visible for distances up to 125 ft. and is especially effective in penetrating deposits on gage glasses, dust particles in the air and extraneous light.

YARWAY

water columns and gages

New Wabash River Station of Public Will Boost System's



NEW WABASH RIVER STATION, West Terre Haute, Ind., of the Public Service Company of Indiana, Inc., designed by Sargent & Lundy, Inc., consulting engineers, will have four Foster Wheeler reheat-type steam generators with the following capacity:

Maximum continuous capacity

Primary steam flow.....700,000 lb per hr
Reheat steam flow.....624,000 lb per hr

Operating pressure

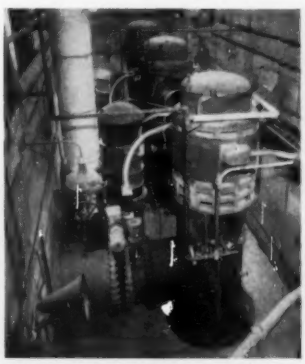
Superheater outlet .....1500 psig
Reheater outlet ..... 401 psig

Final steam temperature.....1005 F

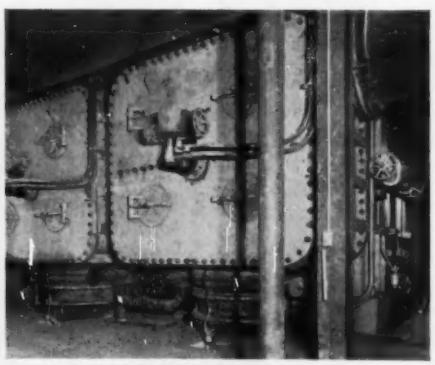
Final reheat temperature.....1005 F

Feed water temperature..... 451 F

Coal pulverized by Foster Wheeler ball mills, two for each steam generator.



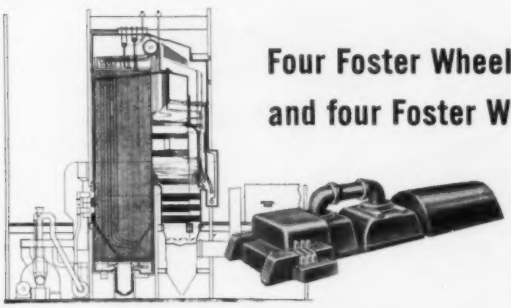
Foster Wheeler vertical circulating pumps, two of which provide a total of 62,000 gallons per minute of cooling water to each condenser.



One of four "double-flow" Foster Wheeler condensers, of the 70,000 sq ft rectangular, two-pass design.

Service Company of Indiana, Inc.
Output Capability to 940,000 kw

...*with four reheat cycle steam generators!*



Four Foster Wheeler 700,000 lb/hr reheat steam generators and four Foster Wheeler 70,000 sq ft "double-flow" condensers will serve turbines each with a gross generator output of 100,000 kw.

Designed to operate on the reheat cycle, the four Foster Wheeler steam generators at the new Wabash River Station of the Public Service Company of Indiana, Inc. will have an aggregate capacity of 2,800,000 lb steam per hr.

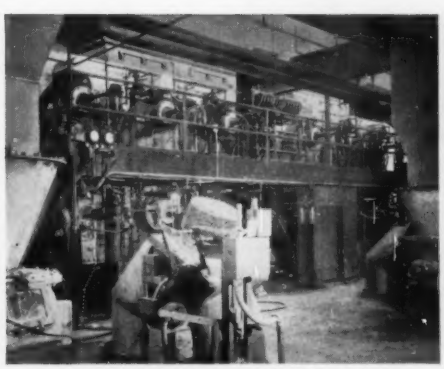
The use of combination radiant and convection superheaters makes possible precision control of final steam temperature over a wide load range. Since superheating is done partly in the radiant section, the gas temperature leaving the furnace can be sufficiently reduced so that, even with the Indiana coal used, complete freedom from furnace slagging is assured.

An all-convection reheater is located deep in the low-gas-temperature zone beyond the convection superheater section. Here safe metal temperatures are maintained during starting, shutting down and under emergency operating conditions. Reheater final steam temperature is controlled by regulation of by-pass dampers located at the economizer outlet.

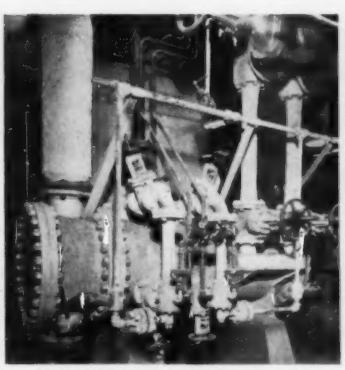
Outstanding features of the "double flow" type condenser are its inherent deaerating action and its complete utilization of available headroom. Also incorporated is a special provision for reversing the circulating water flow, thereby providing a desired cleaning action of condenser tubes.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

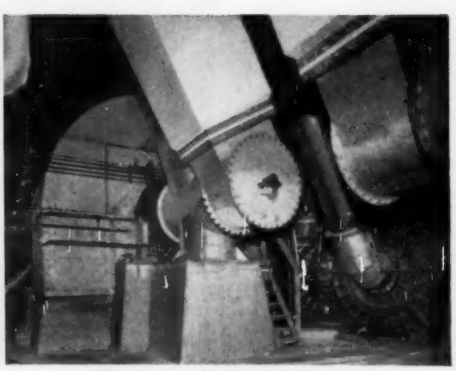
FOSTER WHEELER



Firing aisle of one of the reheat boilers shortly after initial start-up.



Twin-element two-stage steam-jet air-ejector, with combined surface inter- and after-condensers, maintains vacuum in each 70,000 sq ft condenser.

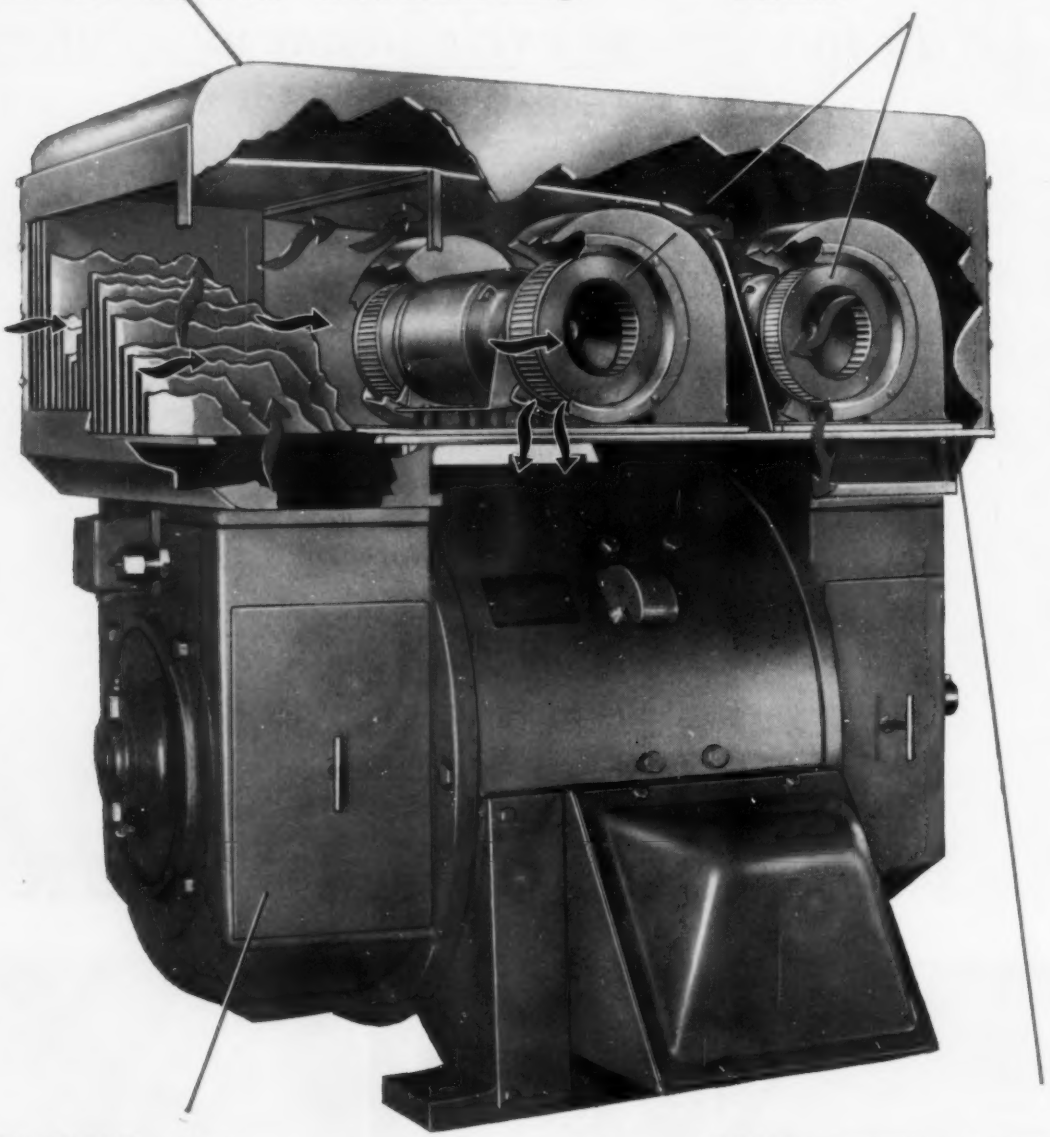


Exhausters and ball mill pulverizers located on basement level.

NEW G-E UNIT-COOLED

DOUBLE VENTILATION SYSTEM: Outside room air (black arrows) enters cooling unit through external portion of the heat exchanger. This air cools the exchangers inner walls, which in turn cool the permanently trapped air. Clean air (red arrows) remains within the unit and never mixes with outside room air. End blower continuously circulates clean air over the motor windings.

TWO BLOWERS operate the double ventilation system and are powered by separate General Electric totally-enclosed fan-cooled motors independent of the main motor.



INSPECTION OPENINGS are gasketed for extra protection. They are easily accessible with no tools required.

COMPACT, top-mounted cooling unit, 37% smaller than previous models, falls within over-all length and width of main motor and is easily removed if necessary.

Progress is our most important product

GENERAL ELECTRIC

D-C MOTOR

Gives you the benefits of d-c speed control — the protection of totally enclosed construction.

WHAT IS THE UNIT-COOLED D-C MOTOR?

It is a Type CD machine with an integrally mounted air-to-air-heat exchanger. Within the exchanger are two separate blower assemblies which operate the unit's double ventilation system. Permanently trapped air cools the motor and in turn is cooled by the outside air being pulled through the heat exchanger.

WHERE DO YOU USE IT?

The new G-E Unit-cooled d-c motor is specifically designed for environments which make open or partially enclosed motors difficult or expensive to maintain. When dampness, metal particles, dust, dirt, oily vapors, fly ash or other harmful airborne materials are present, this new, better protected motor offers real operating economies.

WHAT ARE ITS ADVANTAGES?

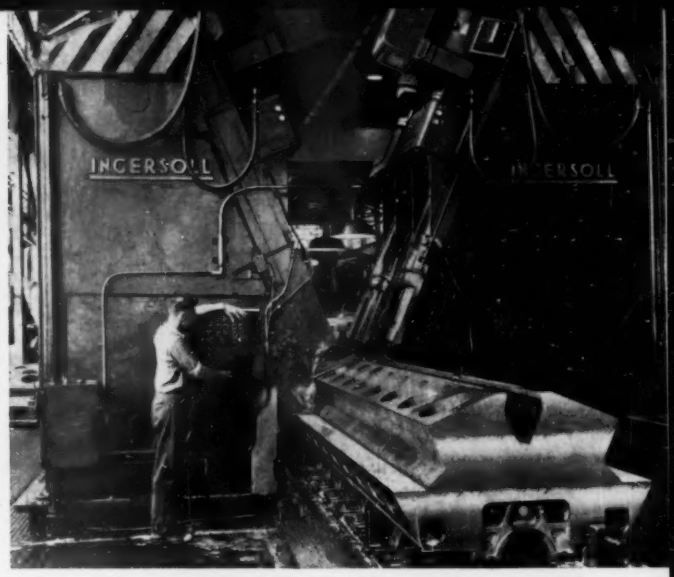
WIDE SPEED RANGE OPERATION. Independent ventilation system allows full use of inherent speed ranges of the d-c motor. Ventilation is not dependent upon main motor speed.

LOWER INSTALLATION COST. Unit has no external duct work, blowers or air filters to install. A completely self-contained unit, it can be relocated or replaced easily and quickly.

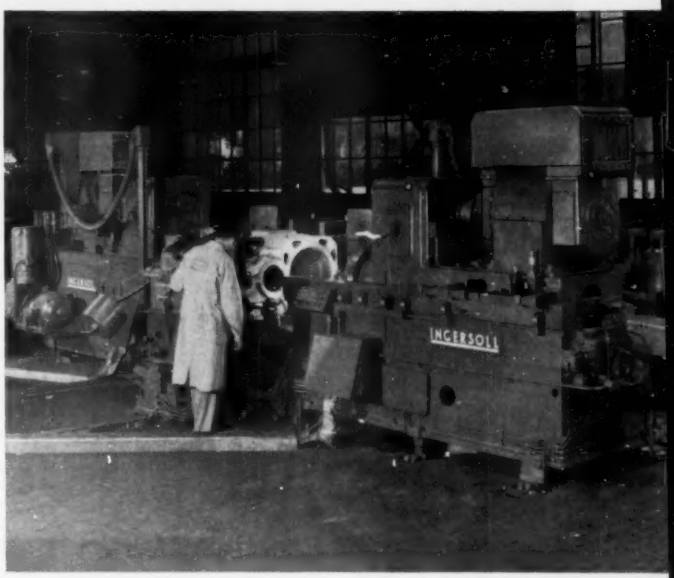
LESS MAINTENANCE. There are no air filters to replace or clean. Self-cleaning vertical heat exchanger plates are used instead of horizontal type. Inspection doors are gasketed and easily accessible with no tools needed.

SMALLER SIZE. Unit-cooled d-c motors are built in smaller frames than non-ventilated or fan-cooled motors of the same rating. This gives you smaller size, less weight and lower armature inertia which is important in applications which require frequent and rapid speed changes or reversals.

AVAILABLE IN *ALL* STANDARD RATINGS from 15-200 hp, in constant and adjustable speed types. For more information on the new G-E Unit-cooled motor, contact your nearest G-E Apparatus Sales Office or fill out the attached coupon for a copy of the Unit-cooled motor bulletin. General Electric Co., Schenectady, N. Y.



MOUNTS AT ANY ANGLE. Here two G-E Unit-cooled d-c motors drive a boring machine used for boring diesel engine blocks.



NO DUCTS OR PIPING. Ventilation system of G-E Unit-cooled d-c motor is self-contained. Smooth lines facilitate cleaning.

General Electric Co.
Section F 810-1
Schenectady 5, New York

Please send me a copy of Bulletin GEA-6091 on the new G-E Unit-cooled d-c motor.

( ) for planning an immediate project
( ) for reference only

NAME.....

COMPANY.....

ADDRESS.....

CITY..... **STATE**.....

OPERATOR CHECKS READINGS OF HAYS ELECTRONIC OXYGEN METER WHEN BURNING MULTIPLE FUELS

THESE INNOVATIONS IN BOILER PLANT INSTRUMENTATION ARE MAKING NEWS

New instruments meet demands of outdoor boilers, space saving, greater speed of response, multiple fuel firing

Boiler plant instrumentation is changing.

Electrically operated combustion control is being used more and more as larger numbers of outdoor boilers are installed. For all-weather operation electric combustion control is preferred since electricity doesn't freeze, is readily available, doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

More miniature indicators and control stations mounted on console or graphic panels are appearing as operators demand more instruments in less space. All essential information is concentrated for fingertip control while supplementary indications and recordings are located on adjacent standard size panels.

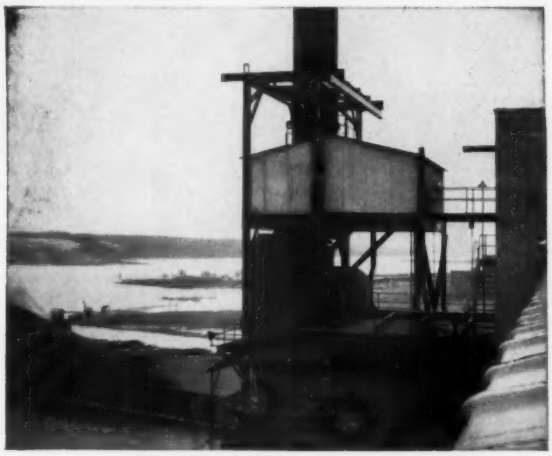
Electronic instruments are becoming more numerous because they give faster speed of response and greater accuracy, can be placed anywhere, eliminate pressure lines into the panel.

Oxygen recorders have become standard equipment where fuel flexibility is desired. Unlike other combustion guides, oxygen measurement is unaffected by the varying Hydrogen-Carbon ratios of different fuels, hence gives the *only* accurate check where more than one fuel is being burned.

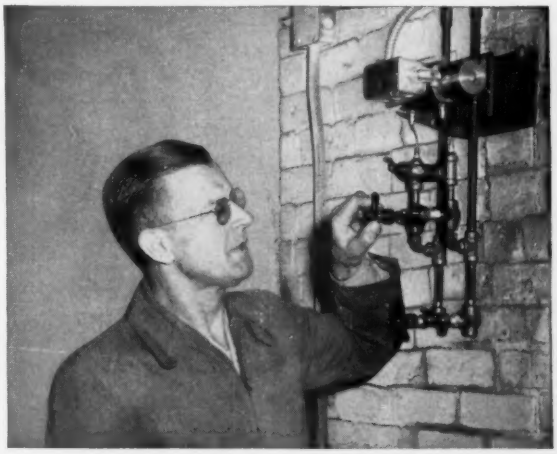
In response to these trends The Hays Corporation offers the complete, modern boiler plant instrumentation line including electric combustion control; highly visible, internally illuminated Miniscales; custom-made panels; new electronic mercury-less flow meters; new 1, 2 and 3 element electronic feedwater control; combustion guide instruments of every type including the Magno-Therm electronic oxygen recorder.

Write for free bulletins on any of these products—available from The Hays Corporation, Michigan City, Ind.

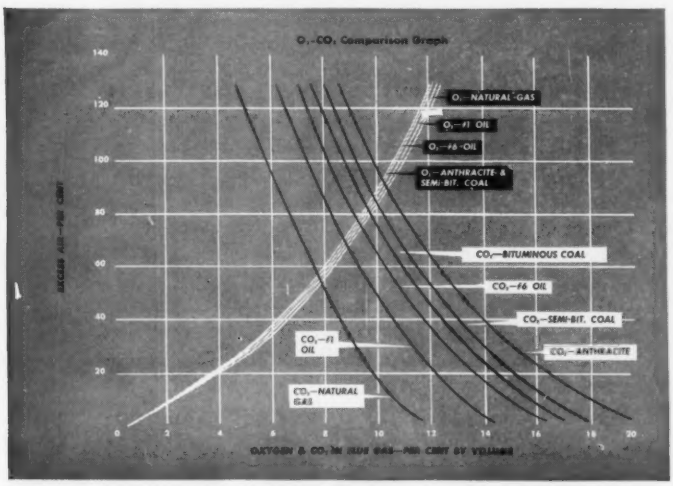
MORE INSTRUMENTS IN LESS SPACE has been accomplished with Hays Miniscales on a console panel. Miniscales indicate any variable. Transmission is either electrical or pneumatic on highly visible, internally illuminated 5″ scales. Hays console panels are custom-made to conform to individual specifications.



OUTDOOR BOILERS, which eliminate the need for expensive enclosures, demand all-weather dependability from controls. Hays all-electric combustion control doesn't freeze, eliminates expensive dryers and compressors.



ELECTRONIC INSTRUMENTS have greater speed of response and accuracy. Here operator inspects transmitter of new Hays electronic mercury-less flow meter. Recorder can be located at remote distances from transmitter.



IN BURNING MULTIPLE FUELS only 0_2 gives an undistorted picture of excess air present in flue gas — as demonstrated by this graph.

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

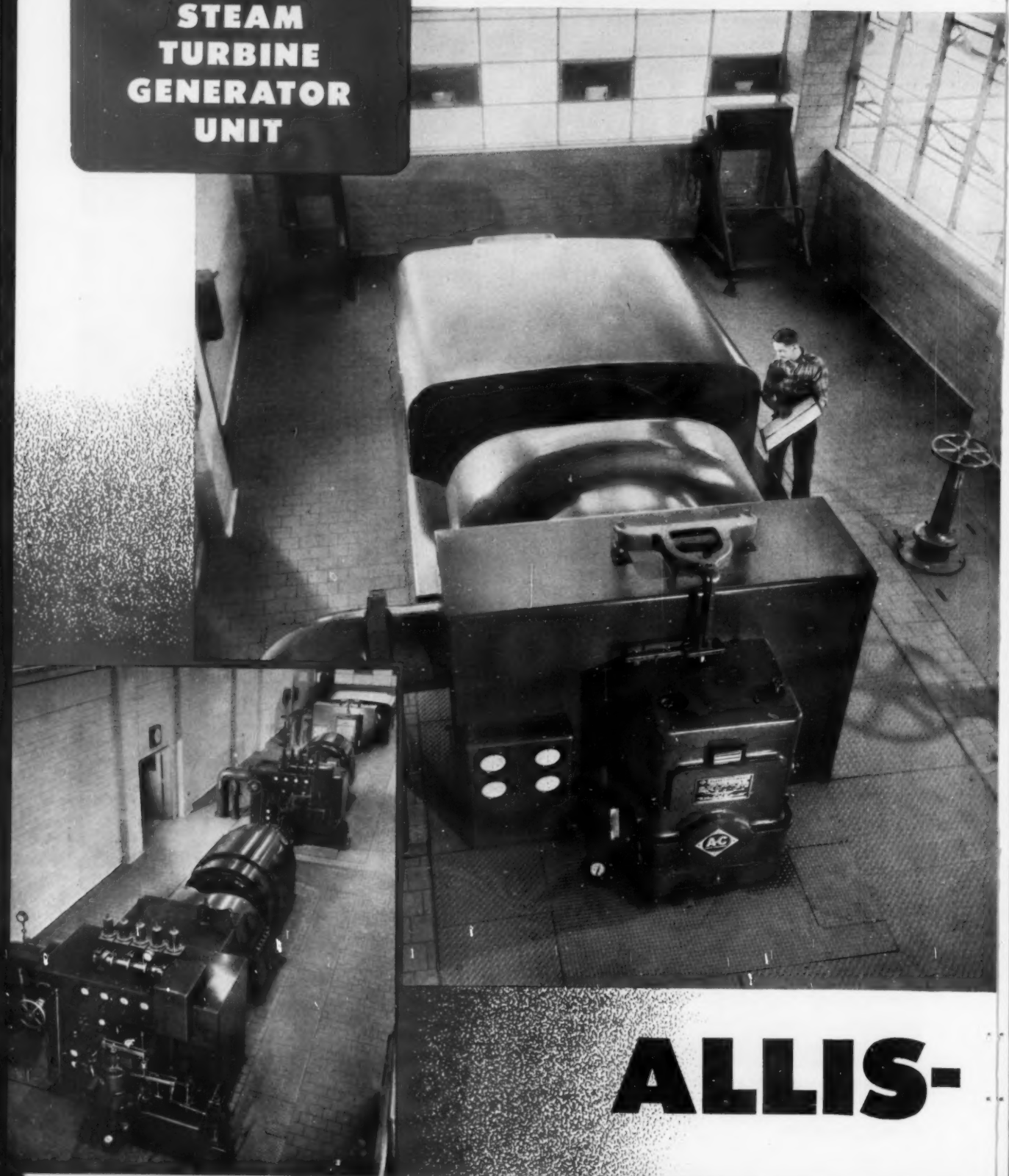
THE hays CORPORATION

MICHIGAN CITY, 3, INDIANA

Steam

WA-Series

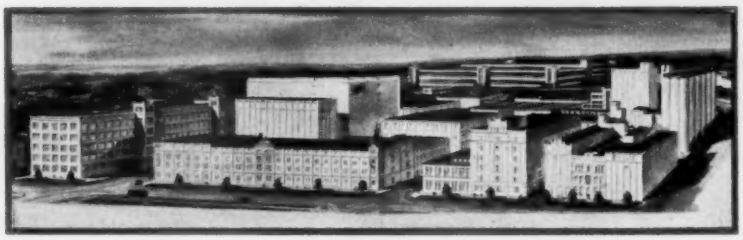
STEAM TURBINE GENERATOR UNIT



ALLIS-

Works Twice

FOR WORLD-FAMOUS BREWER



Jos. Schlitz Brewing Company Uses Steam for Both Processing and Power Generation

Great quantities of steam are required for production of the "beer that made Milwaukee famous" at a rate exceeding six million barrels of beer a year. With so much steam needed for process, the electric power needed for plant operation is generated as a by-product.

At the Schlitz home plant in Milwaukee, two Allis-Chalmers 2500-kw, automatic extraction condensing turbine-generator units have been supplying process steam and electric power for the past five years. Recently, when more generating capacity was needed to match rapid plant expansion, Schlitz again turned to Allis-Chalmers.

Now operating 24 hours a day, 7 days a week, the new 5000-kw turbine-generator shown here was installed in the space originally planned for a third 2500-kw unit. It consists of a condensing, automatic extraction, impulse turbine and a housing type, air-cooled generator and exciter all carefully engineered and manufactured to operate as an integrated unit.

Built for condensing or non-condensing service in NEMA standard ratings 2000 kw and larger, the modern WA-Series unit is designed to meet modern power plant requirements. Bulletin 03B7654 gives complete details. For your copy, just call your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4269

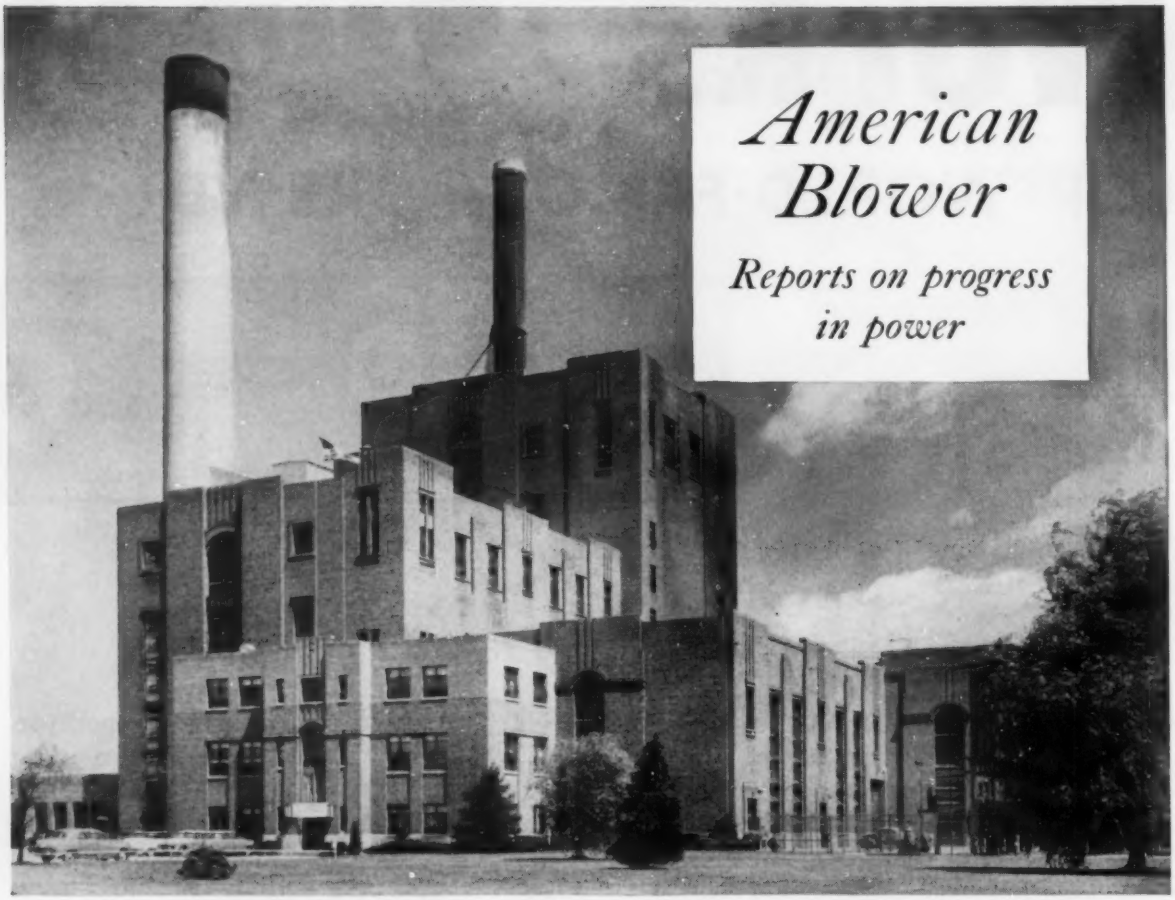
WA-Series Features

For easy installation and maintenance, every detail of the unit is designed for maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit that simplifies foundation requirements. Shipment of the turbine and the generator with their rotors in place further minimizes installation time.

Maximum reliability is assured by labyrinth spring-backed steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

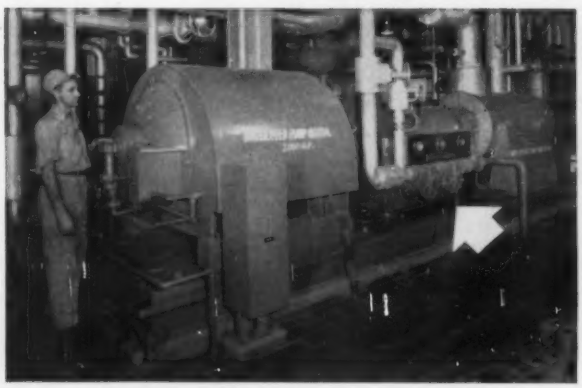
CHALMERS

A-C ALLIS-CHALMERS

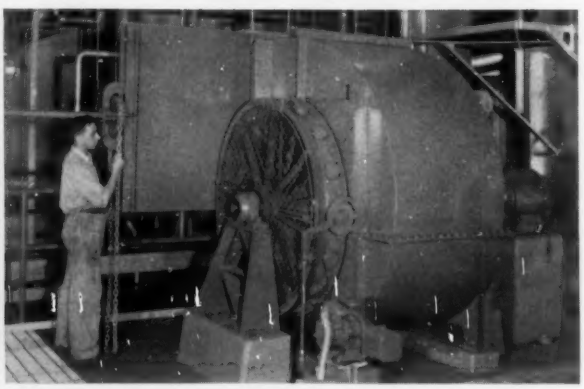


Pennsylvania Power's New Castle Power Plant serves the needs of a 1400 square mile area in western Pennsylvania.

Penn Power adds 85,000 kw. steam-electric

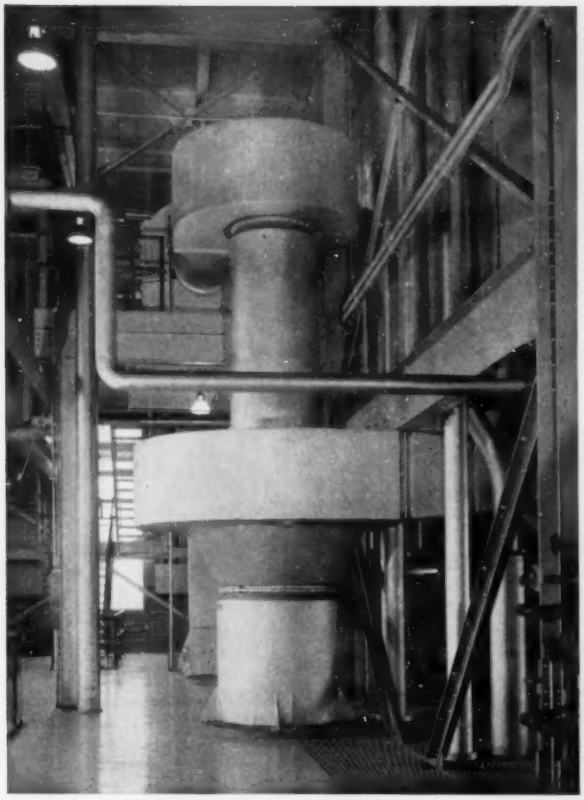


An American Blower Gyrol Fluid Drive (arrow) controls the Boiler Feed Pump at Pennsylvania Power's New Castle Plant.

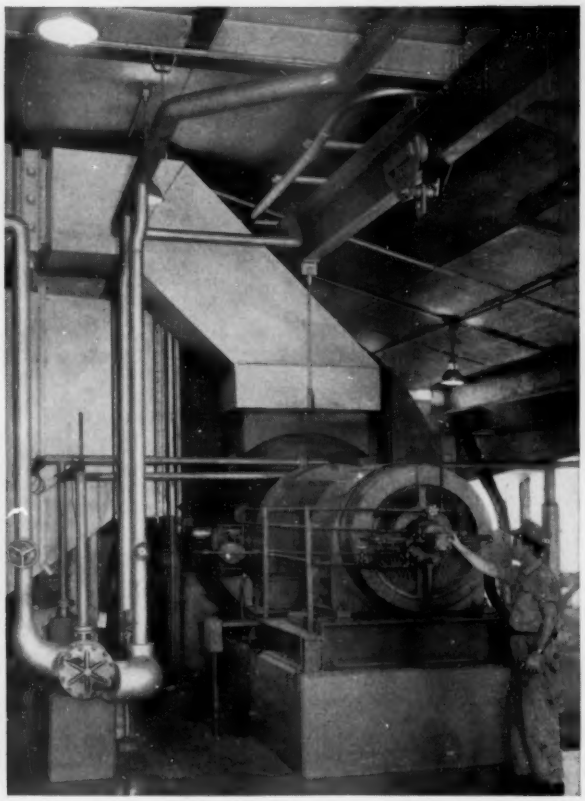


Shown above is an American Blower Tempering Air Fan for use with the new generating unit. It is a single width fan.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS

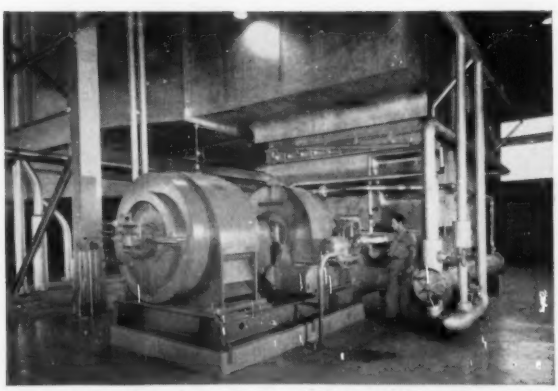


American Blower Fly Ash Precipitator and Secondary Dust Collectors are installed in the New Castle Plant's new generating unit. Primary collectors have capacities of 315,000 cfm at 275° F. and 2.2" SP wg, 210,000 cfm at 275° F. and 1.07" SP wg, and 105,000 cfm at 275° F. and 0.32" SP wg.



Shown is double width, double inlet American Blower Forced Draft Fan being driven through an American Blower Gyrol Fluid Drive. Its capacity is 230,000 cfm of 100° F. air at 12" wg static pressure. American Blower engineers will help you plan mechanical draft equipment for your exact needs.

generating unit



Sirocco Induced Draft Fan with Gyrol Fluid Drive, has capacity of 350,000 cfm of 275° F. gas at 15" wg static pressure.

Like other investor-owned electric utilities, Pennsylvania Power Company is constantly planning ahead to meet future electricity needs.

The latest expansion – an 85,000 kilowatt turbo-generator for the New Castle Power Plant – is the largest in the company's history. Not counting transmission facilities, the new addition represents an investment of $12,771,000.

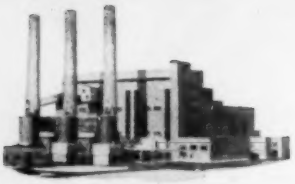
American Blower products – Mechanical Draft Fans, Dust Collecting Equipment and Gyrol Fluid Drives – are used in the new Pennsylvania Power generating unit because of their proven dependability and long-term economy.

American Blower engineers will be pleased to cooperate in *your* expansion program. Consult the nearest American Blower Branch Office or write us direct.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, CANADA
Division of American Radiator & Standard Sanitary Corporation

KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

AMERICAN BLOWER



Metropolitan Edison Co.
TITUS STATION

Niagara Mohawk Power Corp.
DUNKIRK STATION

10

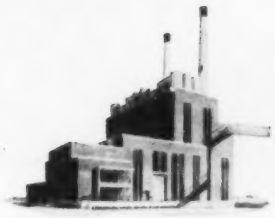
Public Service Electric & Gas Co.
SEWAREN GENERATING STATION

Wisconsin Electric Power Co.
PORT WASHINGTON STATION

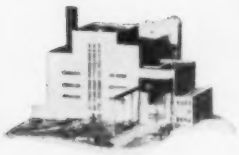
Rochester Gas & Electric Corp.
RUSSELL STATION

Tennessee Valley Authority
JOHNSONVILLE STEAM PLANT

Dayton Power & Light Co.
O. H. HUTCHINGS STATION



Cincinnati Gas & Electric Co.
WALTER C. BECKJORD STATION



Central Hudson Gas & Electric Corp.
DANSKAMMER POINT STEAM STATION

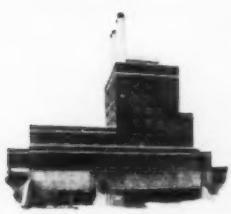
OF THE TOP 15

The annual report of the Federal Power Commission entitled "Steam-Electric Plant Contruction Cost and Annual Production Expenses," covering the year 1952. became available in December, 1953.

Among other interesting and significant data therein were the "Average Btu per Kilowatt-hour Net Generation" rates for 331 power stations reporting from all sections of the country. Ten of the fifteen steam-electric stations having the *lowest* annual heat rates — as revealed by the report — are pictured here.

All the steam generating equipment in these ten stations was designed and built by Combustion Engineering.

B-723A



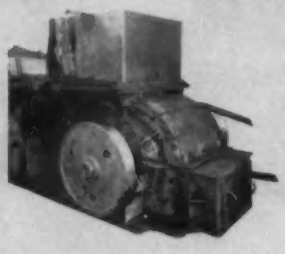
Duke Power Co.
LEE STEAM STATION

COMBUSTION ENGINEERING

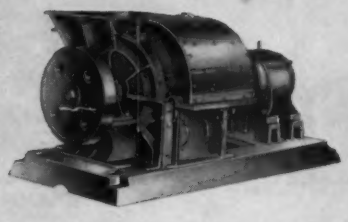
Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

FOR HIGH TONNAGE CRUSHING . . .

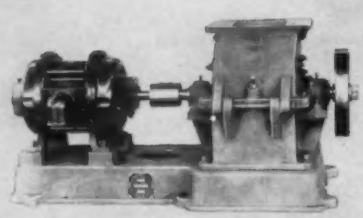


Heavy Duty 30-S. For Primary Crushing. Crushes ROM coal, rock, slate, sulphur balls and gob—high tonnage without oversize. Saves labor costs of pickers.

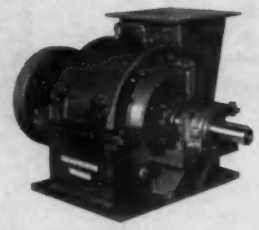


"S" Series. 9 sizes. Capacities up to 500 TPH. High tonnage with minimum fines. Well suited to power plants.

OR COAL SAMPLING . . .



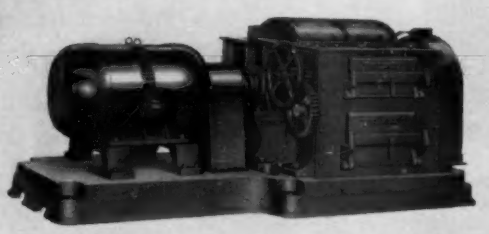
Laboratory Mill. 2 sizes. Capacities up to 2000 lbs./hr. Very efficient for coal sampling.



"13" Series. Three sizes. Capacity up to 6 TPH. For experimental runs, testing, and pilot plant operations.

THERE'S AN *American* ROLLING RING CRUSHER . . . FOR YOUR OPERATION!

"WC" Series. 4 sizes. Capacities up to 90 TPH. Available with drop cage. Compact, requires minimum headroom.



"AC" Series. 17 sizes. Capacities up to 800 TPH. Dual adjustability for easy size control. Drop cage for easy cleanout.

WRITE for details today. Describe your crushing needs.

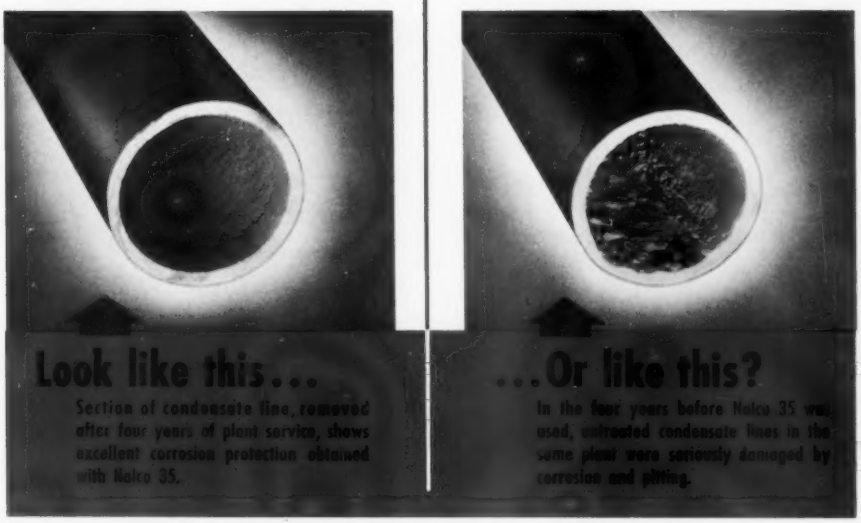
American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 Macklind Ave.
St. Louis 10, Mo.

In the next 4 years...

Will your condensate return lines



Look like this...

Section of condensate line, removed after four years of plant service, shows excellent corrosion protection obtained with Nalco 35.

...Or like this?

In the four years before Nalco 35 was used, untreated condensate lines in the same plant were seriously damaged by corrosion and pitting.

See next page for data on how to keep your condensate return lines clean and corrosion-free . . . permanently.

THE Nalco SYSTEM...
SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

NATIONAL ALUMINATE CORPORATION
6216 W. 66th Place, Chicago 38, Ill.

Send me:

- ☐ Bulletin 35 . . . "Stop Condensate Corrosion in Return Lines, Tanks and Heaters."
- ☐ Reprint 29 . . . "Use of Amines in Low Make-Up Steam Plant."
- ☐ Reprint 30 . . . "Amines for Corrosion Prevention in Steam Condensate Systems."

NAME _____

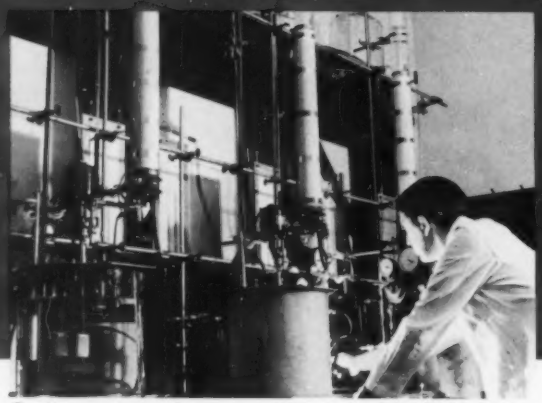
TITLE _____

COMPANY _____

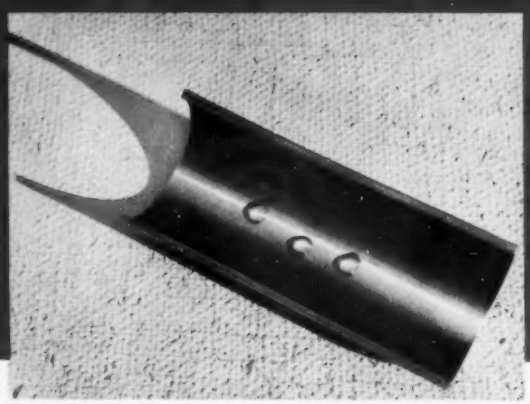
ADDRESS _____

CITY _____ ZONE _____ STATE _____

TWO *Nalco* METHODS FOR POSITIVE CONDENSATE CORROSION PREVENTION



Continuous corrosion-prevention research in Nalco Laboratories has developed outstanding control methods and chemicals for many types of corrosion problems.



Treated with film-forming Nalco 35-FM, this section of condensate pipe shows complete repellence to water droplets. Corrosive condensate never touches metal.

1. *Nalco* 35 PREVENTS CORROSION BY pH CONTROL

Nalco 35 controls pH in the condensate return system . . . neutralizes carbon dioxide to assure corrosion prevention. Especially recommended for low make-up systems, Nalco 35 vaporizes and condenses with the steam, *and at the same rate*. Uniform treatment concentration is assured throughout the system; and long-lasting Nalco 35 makes positive return-line, tank, and valve protection a real operating economy.

2. *Nalco* 35 FM PREVENTS CORROSION BY PROTECTIVE FILM

Nalco 35 FM protects metals in steam systems by forming a tough, rustproof microscopic film on all exposed surfaces. Corrosive gases and liquids cannot reach the metal surface to cause damage.

Nalco 35 FM is fed with a low-cost Nalco condenser-feeder, or any good chemical pump, directly into steam or condensate lines. Once your steam system has protection of Nalco 35 FM film, low dosages maintain film permanently.

***Nalco* WATER TECHS**

Use the postpaid return card to get your copies of up-to-the-minute literature on condensate corrosion control listed on the reverse side of the card.

FIRST CLASS
PERMIT No. 3623
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CHICAGO, ILL.

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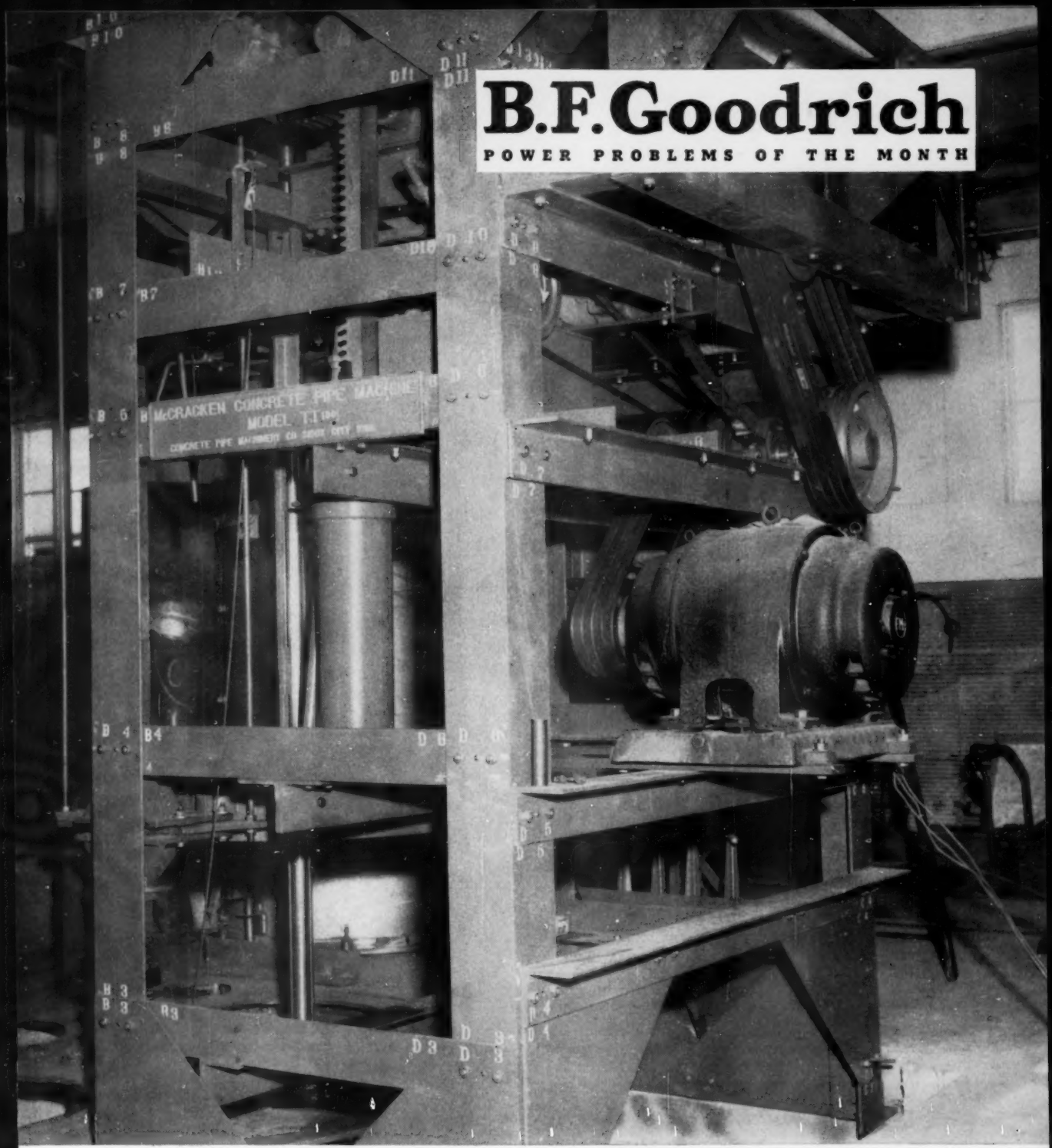
SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE



B.F.Goodrich

POWER PROBLEMS OF THE MONTH

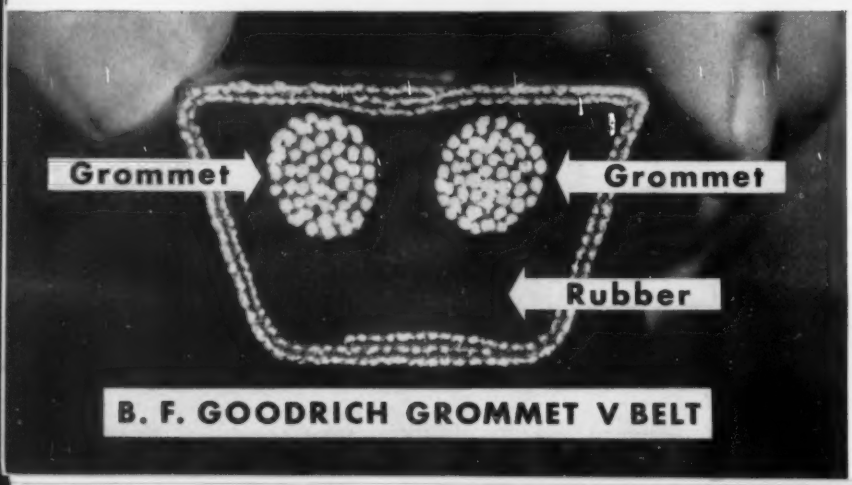
Out of that king-size machine comes concrete pipe, from 4" to 36" in diameter, for underground water lines.

Pipe—the easy way

Sand and cement are poured into the top of that machine. They're mixed, then packed and formed into concrete pipe by centrifugal force. But the jolting action is rough on V belts used to run the whole mass of machinery. Belts wore out fast. Rugged, long-lasting belts are particularly important here because much of this pipe-making equipment is shipped abroad where it can take weeks, even months, to get belt replacements. To find out how this problem was solved, see the following pages.

B.F.Goodrich power problems... (continued)

In the smaller sizes, nearly half a mile of concrete pipe a day, every day, with no shutdowns caused by belt troubles.



The problem described on the preceding page was solved when B. F. Goodrich Grommet V belts were recommended. They worked out so well, that Concrete Pipe Machinery Co. now puts Grommet belts on all their machines. The result? Not one single case of belt failure. This is just one more example of how special compounding of rubber and the husky grommets in B. F. Goodrich V belts give a plus in service, lower operating costs and trouble-free operation!

Strongest V belt made

All the load-carrying cords in Grommet belts are concentrated in twin grommets. These grommets are cord loops made like giant twisted cables except that they're endless. Since there are no center cords, the Grommet belt is more flexible, and so can "give" temporarily and absorb shock loads. As a result, Grommet belts last 20 to 50% longer, depending on the service. (The more severe the service, the greater the increase over ordinary belts.)

No weak spots

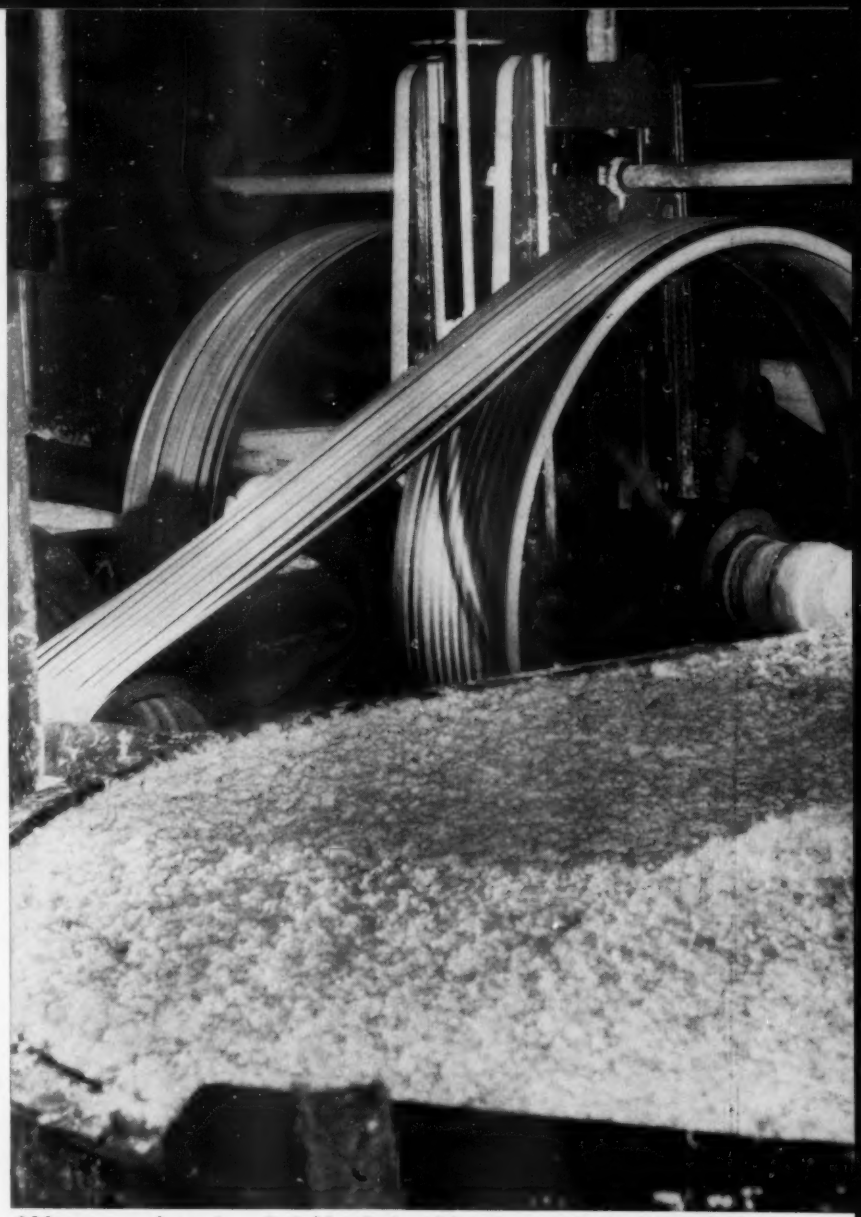
The section where cords overlap is the weak spot in ordinary belts. That's where 80% of V belt failures occur. But in Grommet V belts this cause of belt failure has been eliminated. The grommets are endless. There are no splices or overlaps—no weak spots to cause premature belt failure.

1/3 more gripping power

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip sheaves better. Size for size, Grommet belts give ⅓ more gripping power with less slip, pull heavier loads with a higher safety factor. And because there is less slip, there is also less surface wear.

Less stretch

In ordinary belts under tension, the center cords loaf, the outer cords overwork because tension is greater near the driving faces. Grommet belts, with no center cords, have much more strength and less stretch. Grommet belts stretch, on an average, only about ⅓ as much as ordinary belts.



Old rags are chopped, soaked, bleached and beaten to make fine letter paper.

Turning a profit—on paper

That sudsy-looking stuff is white stationery in the making. Cut up rags are dumped in the tub-shaped beater and chopped and chewed by revolving knives. But keeping this and seven other beaters beating was once a problem. They were all run by belts connected to a single drive shaft. The strain of starting loaded beaters, the constant exposure to water, and the 24-hour-a-day service caused the belts to stretch and slip. And whenever one belt had to be adjusted or replaced, all eight beaters stopped working.

To solve this problem, a B. F. Goodrich man recommended changing over to individual Grommet V belt drives. Since Grommet belts are stronger, and don't slip or stretch as much as ordinary belts, they not only do a much better job of running the beaters but they've also made this operation more profitable by assuring almost continous production.

This performance is typical, not an unusual case at all. Grommet V belts are setting records for longer life, better performance on all kinds of jobs.

Talk to your BFG distributor. Find out how you, too, can make important cost savings with B. F. Goodrich Grommet V belts. *The B. F. Goodrich Company, Dept. M-193, Akron 18, Ohio.*

Grommet—T. M. The B. F. Goodrich Co.

Grommet V-Belts **BY**

B.F.Goodrich

INDUSTRIAL PRODUCTS DIVISION

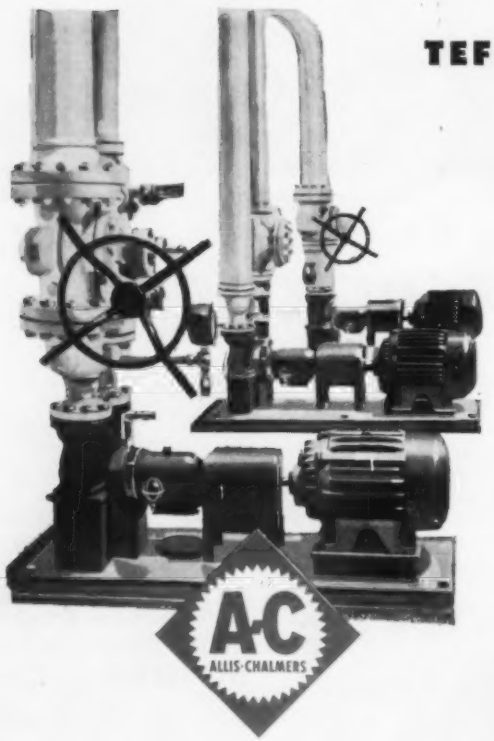
GREATER PROTECTION AGAINST FOREIGN MATTER—LONG

new motors - new

OPEN—DRIP-PROOF

Here are a few of the reasons why the new Allis-Chalmers open—drip-proof motor in NEMA rerate sizes will give you better performance and lower maintenance costs in general-purpose applications.

- Better protection against falling water and debris because cooling air inlets are on bottom.
- Long bearing life because large grease chambers provide plenty of reserve lubricant and are thoroughly sealed against foreign matter.
- Quieter operation, smoother performance.



TEFC and EXPLOSION-PROOF

For especially dirty, corrosive or hazardous applications, you will get top performance with low maintenance costs from the new Allis-Chalmers totally-enclosed, fan-cooled and explosion-proof motors in NEMA rerate sizes. Here are a few of the reasons:

- Foreign matter kept out of bearings and motor interior by double labyrinth seals inside and outside of bearings, and long running fits between shaft and seals.
- Bearing maintenance reduced because large grease chambers provide space for reserve lubricant; also, if required, grease may be renewed without dismantling.
- Easy to clean — no inaccessible air passages. Dirt wipes or blows off easily.

ALLIS-

LIFE BEARINGS—MANY TRIED AND PROVEN FEATURES

GET COMPLETE INFORMATION NOW
Allis-Chalmers, Milwaukee 1, Wis.

Send for these bulletins:

- ☐ Open — Drip-Proof, Type G, 51B6210
- ☐ TEFC, Type GZ, 51B7225
- ☐ Explosion-Proof, Type GZZ, 51B7286

Name.....

Company.....

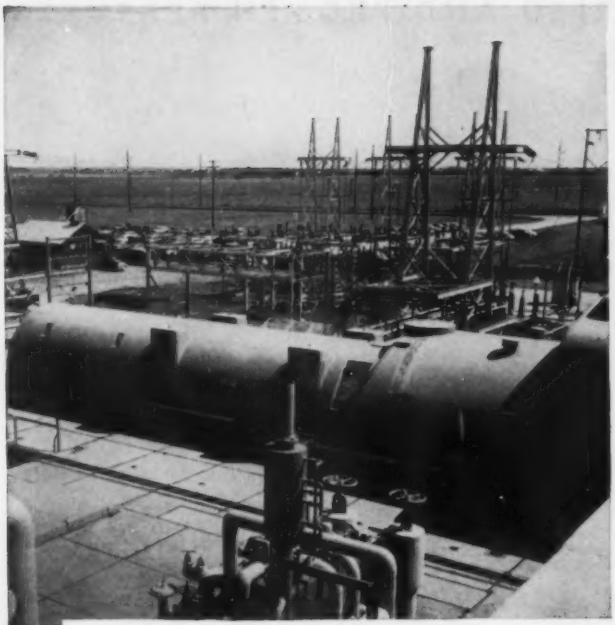
Position.....

Address.....

City and State.....

A-4280

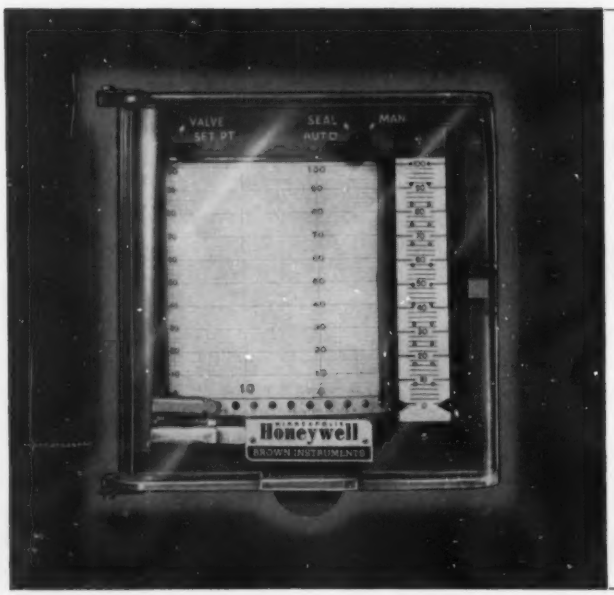
CHALMERS



FUNCTIONAL DESIGN *is the keynote of the New Murray Gill Station designed by Ebasco for Kansas Gas & Electric Co. Above is an outdoor-mounted 47,000-kw generator unit.*

ON THE BACK OF THE CONTROL PANEL *are grouped full-size instruments such as these ElectroniK temperature recorders. But look on the operating side . . .*

Tel-O-Set recorders on compact



Every feature you need in a miniature recorder

Tel-O-Set recorders are applicable to measurements of temperature, pressure, flow and liquid level. They embody a simple, rugged pneumatic receiving system that is actuated by low-pressure air from the remote transmitter.

The recording chart moves horizontally. A full 8-hour record is quickly available.

The panel cutout required is only five inches square. In the mounted position, the instrument can be withdrawn from its case for easy inspection and adjustment.

...THE FRONT OF THE PANEL, *only eight feet in length per unit (two units shown), where operators can watch pertinent plant variables on miniature instruments mounted directly on a functional plant diagram.*

show critical trends graphic control panels

BOILER and turbine control panels, which used to stretch for dozens of feet along the sides of a central control room, are now being compressed into small, convenient size. The key to this new technique, pioneered by Ebasco in the power industry, is graphic instrumentation . . . which displays all vital operating variables on a plant diagram. Graphic panels bring complete plant operation into sharp focus . . . improve operator's efficiency . . . speed training of new men . . . and simplify start-up and emergency control.

For displaying the many variables which need more than instantaneous indication, *Tel-O-Set* miniature recorders are ideal on graphic panels. They take no more panel space than many dial indicators. And they provide a record which reveals trends, so that operators can know which way related variables are moving, and how fast.

When you're planning graphic instrumentation, plan to utilize *Tel-O-Set* recorders for these essential "trend indicators." Your nearby Honeywell sales engineer will be glad to discuss how they can be applied to your own control panels. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Bulletin No. 9050, "Instrumentation for Steam Generation."**

MINNEAPOLIS **Honeywell**

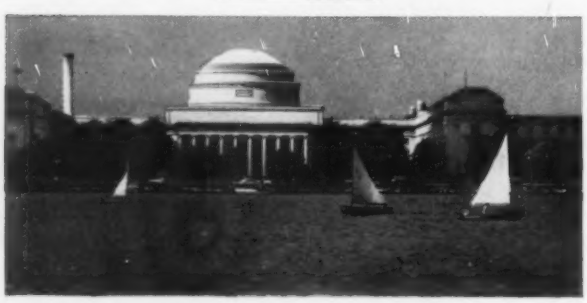
BROWN INSTRUMENTS

First in Controls

Another M. I. T. *Building Equipped*

In this Famous Scientific Institute Powers thermostatic control for heating and air conditioning systems is used in the new Dorrance Laboratory for Biology and Food Technology and in the buildings listed below.

- **MAIN EDUCATIONAL AND ADMINISTRATION BUILDINGS**
- **GAS TURBINE LABORATORY**
- **CHEMICAL ENGINEERING BUILDING**
  Architects: Coolidge and Carlson • Contractor: The Downey Co.
- **HAYDEN MEMORIAL LIBRARY**
  Architects and Engineers: Vorhees, Walker, Foley and Smith
  Contractor: Cleghorn Co.
- **NUCLEAR SCIENCE LABORATORY**
  Architects: Anderson & Beckwith • Contractor: The Merrill Co., Inc.
- **SWIMMING POOL BUILDING**
  Architects: Anderson & Beckwith
  Engineers: Wolff & Munier • Contractor: H. E. Whitten Co.
- **NEW AUDITORIUM, now under construction**
  Architects: Eero Saarinen & Associates
  Associate Architects: Anderson & Beckwith
  Engineer: Hyde & Bobbio • Contractor: H. E. Whitten Co.



Other Prominent Users of

UNITED STATES CAPITOL
House and Senate Chambers
UNITED NATIONS
General Assembly
and Conference Buildings
HARVARD UNIVERSITY
Various Prominent Buildings

POWERS CONTROL
TEMPERATURE AND HUMIDITY

Argonne National Laboratory • Abbott Laboratories
Aluminum Co. of America • American Telephone & Tel. Co.
American Optical Co. • Anheuser Busch Co. • Armour & Co.
Bendix Aviation Corp. • Bachman-Uxbridge Worsted Co.
Campbell Soup Company • Celanese Corp. of America
Chrysler Corp. • Ford Motor Co. • General Motors Corp.
Douglas Aircraft Co. • E. I. DuPont de Nemours Co.
Esso Research Center • Eastman Kodak Co.
B. F. Goodrich Tire & Rubber Co. • Humble Oil Co.
Johns Manville Co. • Johnson & Johnson Co.
Lever Brothers Co. • Eli Lilly & Co. • Lily Tulip Cup Corp.
Lahey Clinic • Massachusetts General Hospital
Massachusetts Mutual Life Insurance Co.
Monsanto Chemical Co. • Montgomery Ward & Co.
Parke Davis & Co. • Pepperell Mfg. Co. • Sears Roebuck & Co.
Sharp & Dohme Inc. • Swift & Co. • Thompson Products, Inc.
Wm. Wrigley Co. • Hiram Walker Inc. • Wyman-Gordon Co.
New York Stock Exchange • Radio City Music Hall
Madison Square and Boston Garden • Rockefeller Center

JOHN THOMPSON DORRANCE LABORATORY

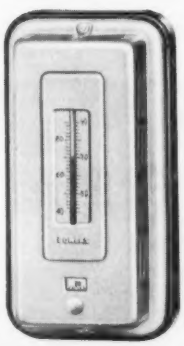
FOR BIOLOGY and FOOD TECHNOLOGY

Architects
ANDERSON & BECKWITH

Engineers
CLEVERDON, VARNEY & PIKE

Contractor
JAS. S. CASSEDY, INC.

with a POWERS Pneumatic System of *Temperature Control*



Powers Room Type Thermostat pneumatically regulates heating and air conditioning systems. Outstanding for accuracy and dependability.

Laboratory with an Exciting Future – From this modern laboratory with its excellent staff and research facilities will come great advances that will surpass the progress of the past and produce discoveries which will benefit us all.

Correct room temperature and humidity is important here. Research labs, animal rooms, constant temperature rooms and classrooms require the even, constant temperature assured by a Powers control system.

When you want dependable, accurate control for heating, cooling or air conditioning for any building or industrial process call Powers. With over 60 years of experience and efficient modern equipment we can help you select the best control for your requirements.

THE POWERS REGULATOR CO.

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

SKOKIE, ILLINOIS • Offices in Over 50 Cities in U. S. A., CANADA and MEXICO

(b46)

custom built systems

HAGAN
automatic combustion controls

HAGAN
ring balance instruments

For thirty-five years the leaders in advancing steam production efficiency with Automatic Combustion Control and Instrumentation Systems.

HAGAN
HALL
BUROMIN
CALGON

from standard components

Custom Built from standard components sounds like a contradiction. But it is a fact that each Hagan unit is designed, not only to perform its specific functions efficiently, but also to operate smoothly in combination with other Hagan components. Thus, every Hagan System of Automatic Combustion Control and Instrumentation can be custom built to maintain the exact operating conditions which result in optimum steam production efficiency.

Thirty-five years of experience with all types of boilers, and with every combination of temperature, pressure and fuel system requirements, goes into the design of every Hagan unit and system. As a result, a Hagan System is thoroughly coordinated and easy to calibrate. Adjustments are ample in number and range, so that our engineers—or yours—can get the entire system into accurate operation with a minimum loss of time.

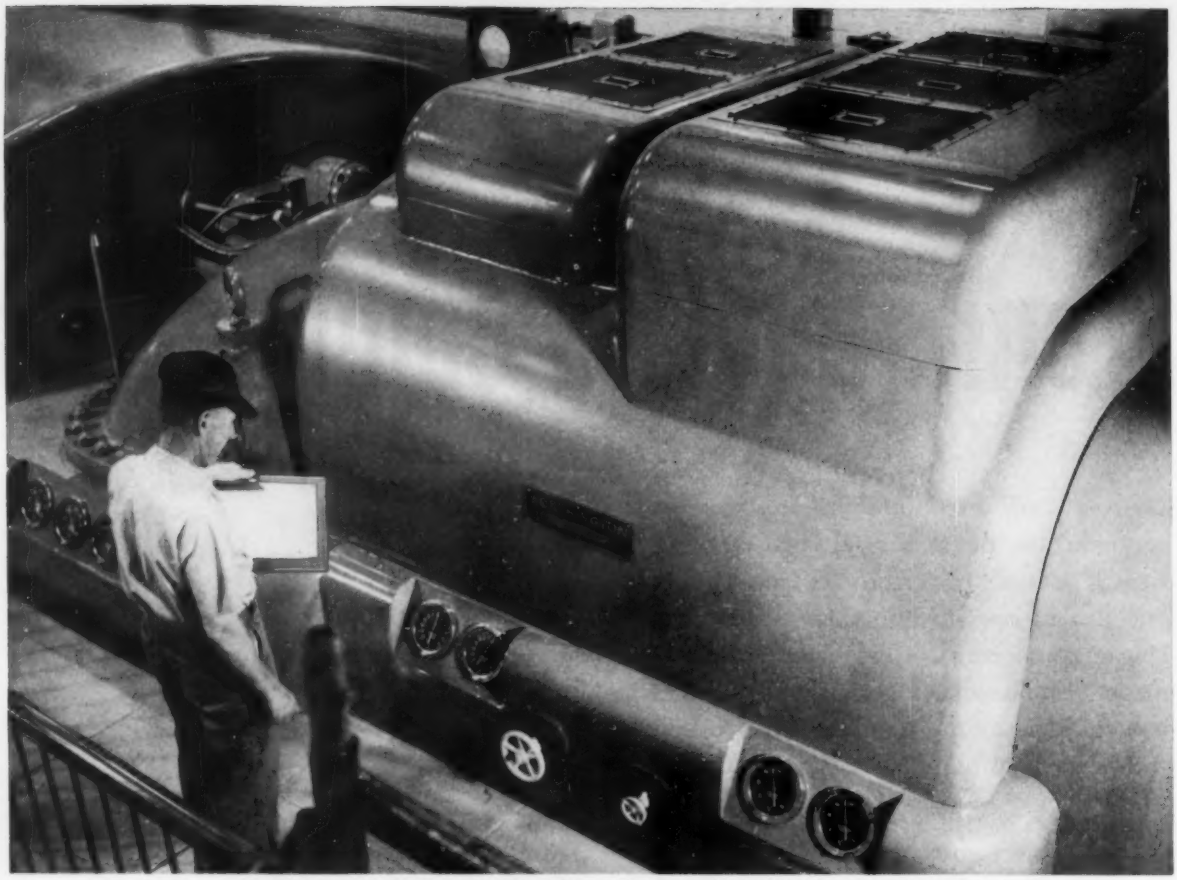
Many of our customers have standardized on Hagan Controls and Instruments for improving existing facilities and for extensions and new construction.

Make Hagan Automatic Combustion Control and Instrumentation the choice for your next installation!

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities



MODERN DESIGN IN TURBINE-GENERATORS. This streamlined Worthington turbine-generator unit at the University of North Carolina is capable of developing 2500 kw over and above the 10,000 kw normally produced. In addition, sufficient steam is automatically extracted to heat the University buildings.

Look how turbine-generators have changed!

Remember the bulky, complicated turbine-generators of only a few years ago?

Compare them with this sleek, powerful Worthington 10,000-kw unit installed at the University of North Carolina last year. Everything about this turbine-generator is modern and up-to-date.

Look at the streamlined heavy steel lagging which covers the turbine, generators and exciter. Note the recessed dials, set at a thirty degree angle so they may be read from standing height with ease. And the dials don't project into the room, where they might be damaged.

In addition to getting the most modern unit of its kind, the University of North Carolina benefitted by the undivided responsibility that goes with every Worthington turbine-generator. Each is designed, assembled, and tested as a complete unit *before* shipment.

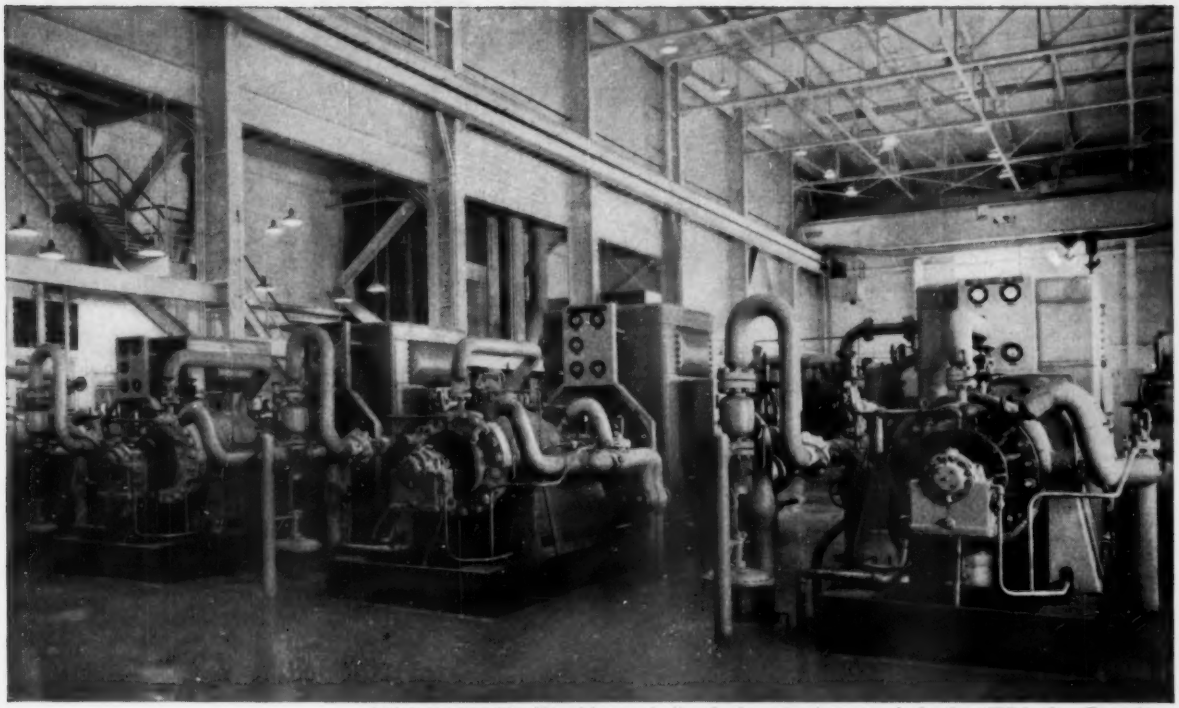
Find out how Worthington turbine-generator sets pay off in longer, more economical power generation service. Sizes range up to 11,500 kw. Get in touch with your nearest Worthington district office for more information. Or write to Worthington Corporation, Steam Turbine Division, Section T.4.2, Wellsville, New York. T.4.2

WORTHINGTON

STEAM TURBINES

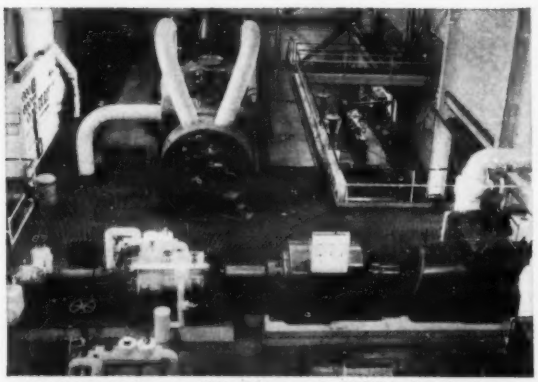
Single- and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers

A GREAT TEAM IN STEAM



FOUR OF THE FIVE Worthington boiler feed pumps in P.G.&E.'s Station "P" in San Francisco. Each of the pumps shown here delivers 1,340 gpm against a discharge pressure of 1,868 psig.

P.G.&E. installs 45 Worthington high pressure boiler feed pumps over 15-year period



LOOKING DOWN on a Worthington 6" WCS boiler feed pump at the Oleum Station of P.G.&E.

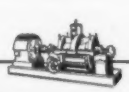
• Pacific Gas and Electric Company, with 3,540,200 kw installed capacity, serves 5½ million people in 46 of California's 58 counties. It's been building new generating plants right and left to keep up with the power needs of this booming area.

P.G.&E. is a satisfied Worthington customer. Since 1938 a total of 40 high-pressure boiler feed pumps have gone to work in seven different stations of the P.G.&E. network — proof that they do a real job for this West Coast utility. And five more of these sturdy Worthington pumps are being built for P.G.&E. right now, all designed to handle pressures over 1850 psig. This is also evidence that Worthington's design and engineering techniques are keeping right up with the greater capacities and pressures of today's steam generating units.

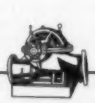
You can put this extensive experience in pump design and manufacture to work in your plant. For details, check with your Worthington district office or write for Bulletin W319B-1C to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

C.3.6

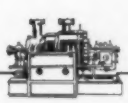
For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.



For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.



For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.



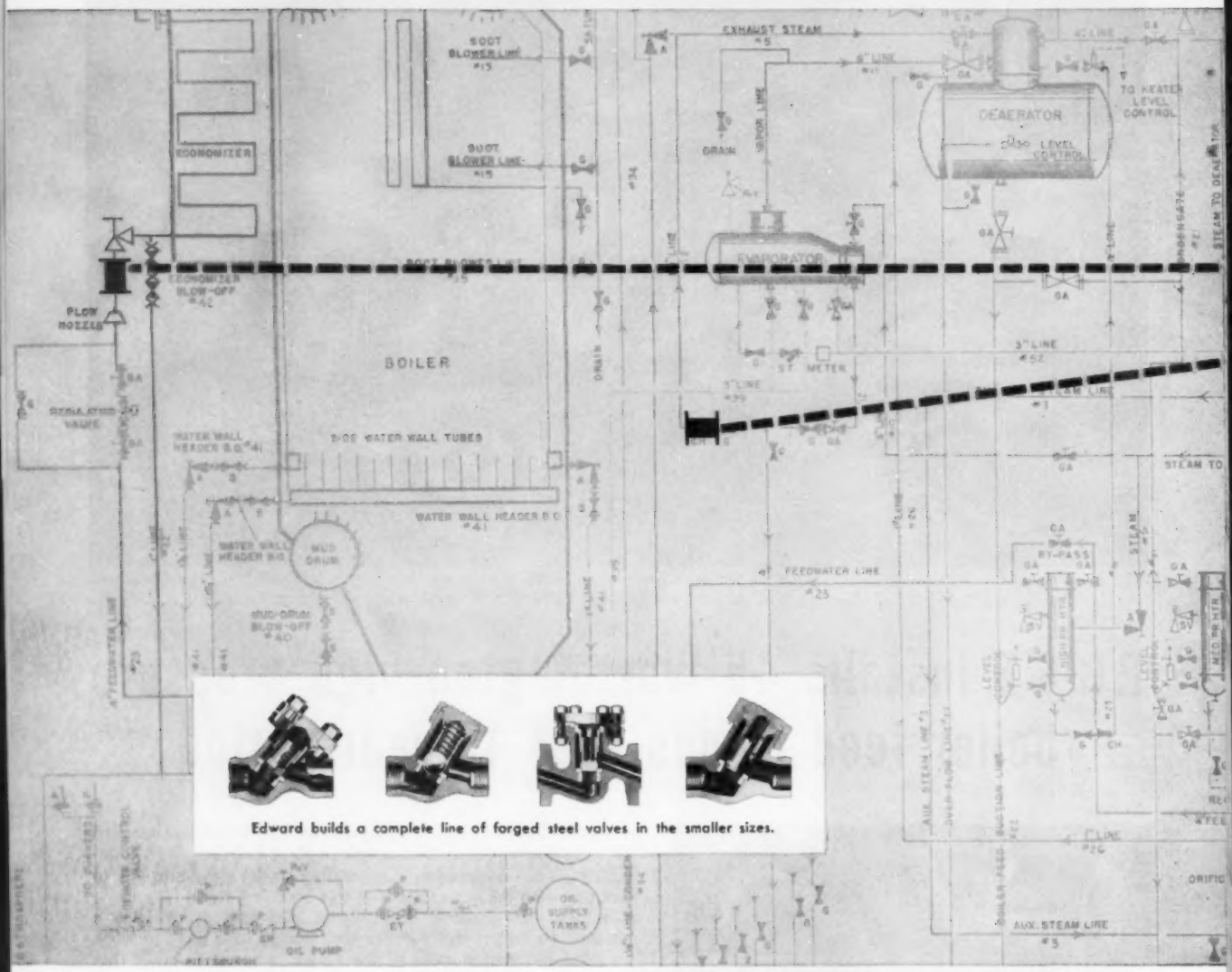
For Boiler Feed Service. Capacities to 3,000 GPM; Heads to 7,000 feet.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job

What you should know about



Edward builds a complete line of forged steel valves in the smaller sizes.

In the 50 years since Edward designed and first built steel valves, experience and research have revealed many facts about check valves. Here are some of the most important.

SELECTION POINTERS . . . that will improve your check valve efficiency.

1 The proper size valve is the most economical. Too small a valve has a high pressure drop and wastes power. Too large a valve requires unnecessary effort to operate and disks may hug the valve seat at low flow causing vibration and excess wear. (Edward Bulletin No. 12H describes a simple method for computina correct check valve size.)

2 In selecting check valves, the piston type has at least five big advantages over the swing type:

(a) dashpot action of piston type check valves prevents slamming—eliminates damaging shock;

(b) disks give a tighter seal;

(c) more complete guiding minimizes vibration of moving parts;

(d) angle designs to replace elbows are possible in piston type check valves;

(e) disks can be easily re-lapped when necessary.

3 In higher pressure steam generating plants, Pressure-Seal bonnet designs are rapidly replacing the cumbersome, heavily-bolted bonnets. Here are several especially desirable features:

(a) pressure-seal bonnets stay tight regardless of temperature-pressure variations;

(b) fewer bolts, lighter covers and bonnets reduce maintenance costs;

(c) pressure-seal offers a higher degree of part interchangeability;

(d) lower pressure drop in streamlined pressure-seal designs permit use of smaller piping and valves . . . saving space, weight and costs.

(e) and pressure-seal construction improves streamlining which reduces wear-inducing turbulence;

(Edward has built PRESSURE-SEAL valves for ten years and its continuing rusearch has developed many new features that reduce maintenance and improve sealing qualities.)

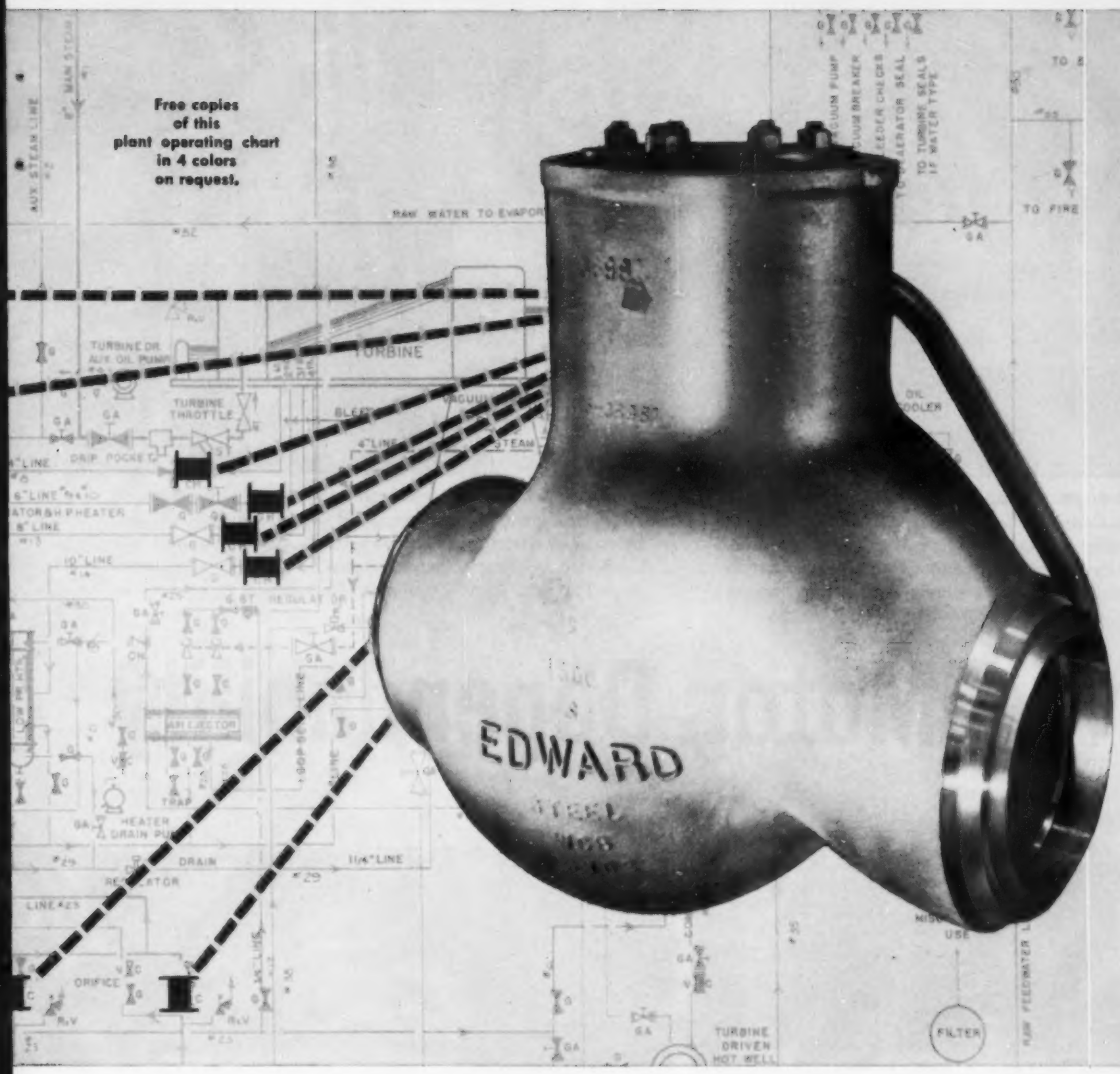
4 High pressure check valves with equalizers require less flow to open. An equalizer is a by-pass which connects the relatively high pressure zone above the disk to the high velocity, low pressure area in the valve outlet creating a semi-vacuum which pulls disk upward. (Every Edward check valve over 600 psi has an Equalizer installed on the right side when facing outlet and the disk seats itself against cover for vibrationless operation and minimum pressure drop.)

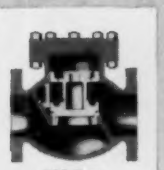
5 Avoid gadgety designs that obstruct flow and tend toward increased maintenance. (Edward check valves are simple. Internal contours are streamlined for free flow. Disk is accurately guided by three smooth, self-scouring, integrally cast ribs that insure perfect closures and full, easy openings.)

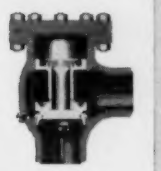
6 "Cushion closing" check valves protect piping from hammer damage and reduce wear. (Edward "piston" check valves are designed for quick "cushion closing" without damaging shock.)

7 In severe services, integral seats eliminate the possibility of leaks behind screwed or welded-in seat rings. (Edward check valves above 600 psi all have integral Stellite hard surface seats applied in a continuous ring directly to the valve body.)

CHECK VALVES*




300 lb sp


600 lb sp

900 lb sp

1500 lb sp

2500 lb sp

BOILER CODE REQUIREMENTS . . . that control check valves:

P-317

(a) The feed pipe shall be provided with a check valve near the boiler and a valve or cock between the check valve and the boiler, and when two or more boilers are fed from a common source, there shall also be a globe or regulating valve on the branch to each boiler between the check valve and the source of supply. Wherever globe valves are used on feed piping, the inlet shall be under the disk of the valve. (Edward globe and gate valves are designed especially for these services.)

(b) When the supply line to a boiler is divided so as to feed a drum in more than one place or to feed more than one drum, it is recommended that each such branch line be equipped with a stop and a check valve even though the common source is equipped as required by (a).

(c) If a boiler is equipped with duplicate feed arrangements, each such arrangement shall be equipped as required by the rules.

(d) A combination stop-and-check valve in which there is only one seat and disk, and a valve stem is provided to close the valve when the stem is screwed down, shall be considered only as a stop valve, and a check valve shall be installed as otherwise provided. (Edward separated type stop-check valves have two separate disks and seats combined in one body.)

(e) Where an economizer or other feedwater-heating device is connected directly to the boiler without intervening valves, the feed valves and check valves required shall be placed on the inlet of the economizer or feedwater-heating device.

A-61 FEED PIPING

The feed pipe of a steam boiler operated at more than 15 psi maximum allowable working pressure shall be provided with a check valve near the boiler and a valve or cock between the check valve and the boiler, and when two or more boilers are fed from a common source there shall also be a globe valve on the branch to each boiler between the check valve and the source of supply. When a globe valve is used on a feed pipe, the inlet shall be under the disk of the valve. (Edward builds globe, check and gate valves designed for these services.)

INSTALLATION IDEAS . . . that foster dependable check valve operation.

1 When installing piston type check valves always have disk traveling in a vertical plane to minimize danger of "hanging-up" or incomplete closures.

2 Never use a horizontal check in a vertical position.

3 Angle valves often save money as well as installation time when used in place of an elbow.

4 Always install check valves with enough clearance so that cover may be removed for maintenance or repairs.

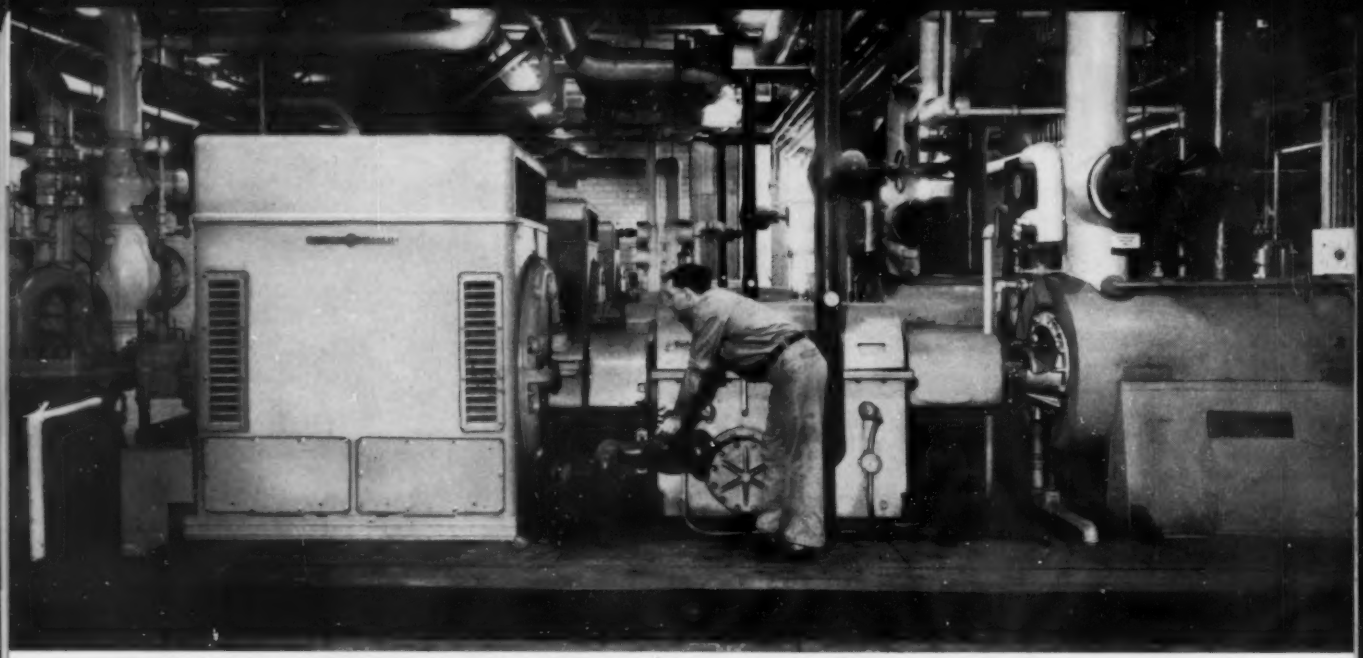
One of a series providing condensed information on valve applications in steam power plants.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

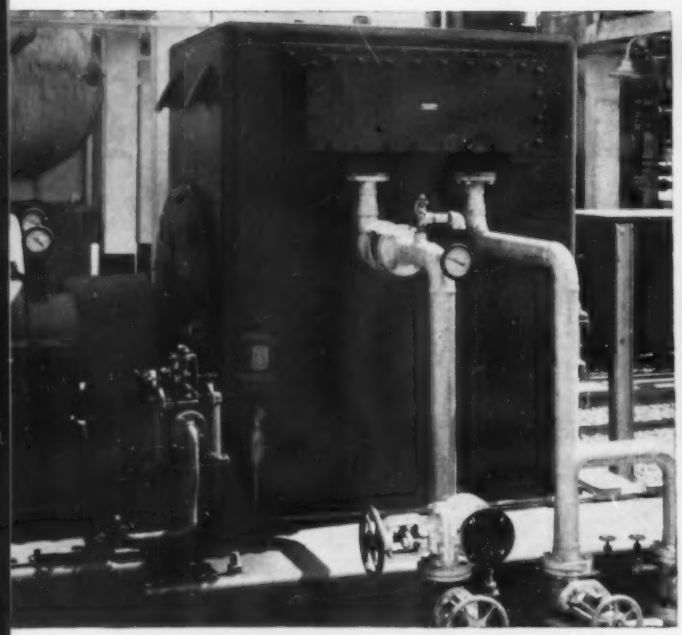
1220 W. 144th STREET
EAST CHICAGO, INDIANA

Another Product

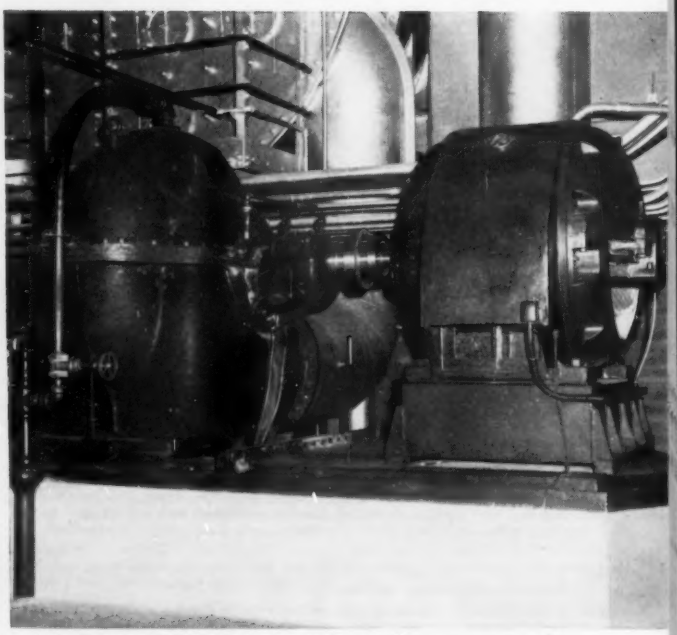


G-E BOILER FEED PUMP MOTORS in a typical application at Detroit Edison's Connor's Creek Plant. Designed especially for boiler feed pump service, 1000 hp ratings and larger, this motor permits closer spacing because of unique ventilating system and cubical shape . . . conserves floor space. You get improved performance from streamlined rotor design which also gives quieter operation. Dual lubrication system combines the advantages of force-flood lubrication and self-lubricated oil rings. Modern appearance blends with power station styling. Write for Bulletin GEA-5813.

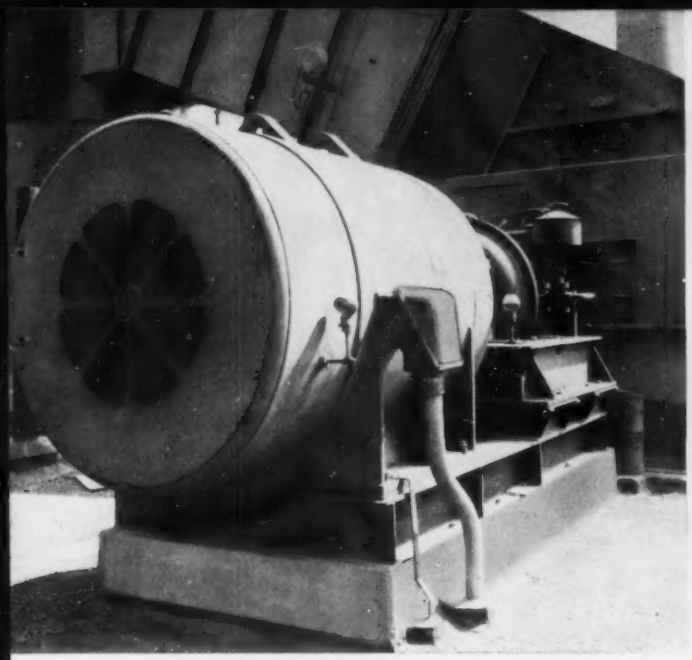
Proved Motor Dependability



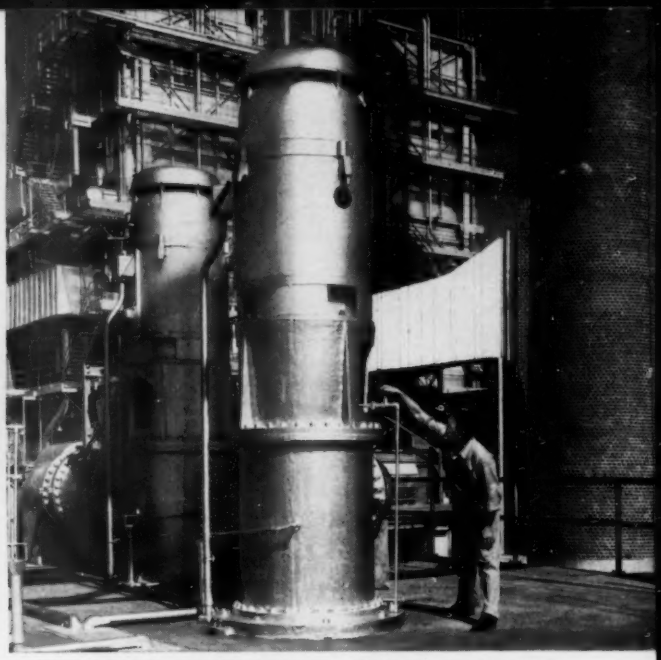
G-E TOTALLY ENCLOSED AIR-WATER COOLED MOTOR is an economical choice for 250 hp and larger. Simple to install, it needs no ducts, filters or blowers. Total enclosure means less maintenance by keeping out dust and other foreign particles. Shown here driving blower in a Kansas plant.



LARGE G-E OPEN DRIPPROOF MOTORS, four or more poles, such as this one coupled to circulating water pump in Cliffside Steam Station of Duke Power Company, are designed for indoor applications only. They are widely used on hot well pumps, forced- and induced-draft fans, and coal pulverizers.

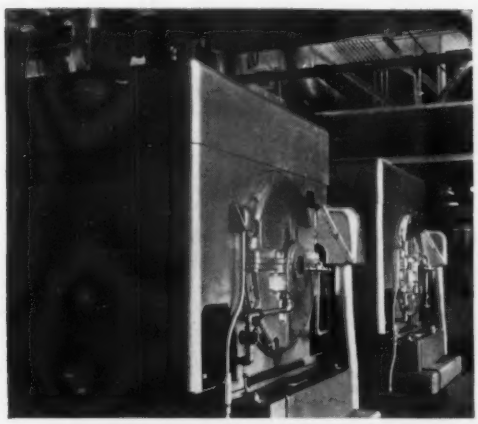


THIS G-E TOTALLY ENCLOSED FAN-COOLED MOTOR drives an induced-draft fan in the Edwardsport Steam-electric Power Station of Public Service Company of Indiana. Total enclosure assures the ultimate in motor protection required for operation in severe atmospheric conditions.



G-E VERTICAL TOTALLY ENCLOSED FAN-COOLED MOTORS, with Tri-Clad* construction, such as these driving pumps at New Orleans Public Service Inc., A. B. Paterson Steam-electric Generating Station, are used for dependable, low-maintenance service in severe ambient conditions.

for Power Station Service



TWO G-E WEATHER PROTECTED MOTORS, grade mounted, driving boiler feed pumps at Florida Power & Light Company's Cutler Plant. Available also in vertical and base ventilated design, this low-cost motor is designed especially for outdoor service where the extra protection of totally enclosed fan-cooled design is not economically justified. Bulletin GEA-5810.

*Reg. Trade-mark of General Electric Co.

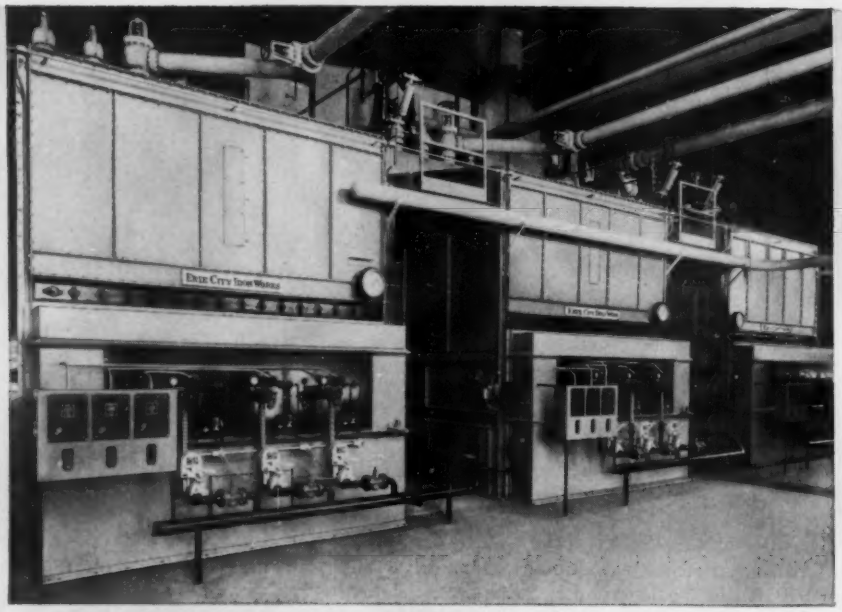
G.E.'s complete line of power station auxiliary motors—field proved—assures you of getting the right motor for every operating requirement and station design.

Power stations across the country have installed dependable G-E motors for every auxiliary use. Because of the extensive field study that General Electric has devoted to power station requirements and the engineering experience gained through building all types of power station equipment for over 70 years, you are always assured of getting the right motor for economical and dependable service.

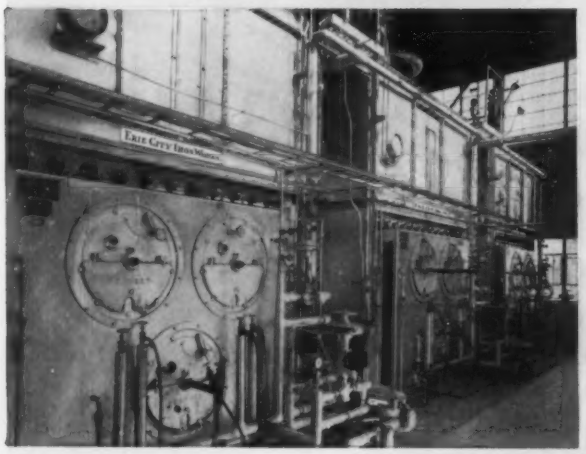
Whatever your needs in power station motors, General Electric can furnish the right type and size from a complete line . . . a wide variety of designs, enclosures, and application variations. You get exactly the motor needed to meet conditions of your operating practice, economics or location.

For more information on G.E.'s complete line of power station auxiliary motors contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, N. Y.* 733-6

GENERAL ELECTRIC



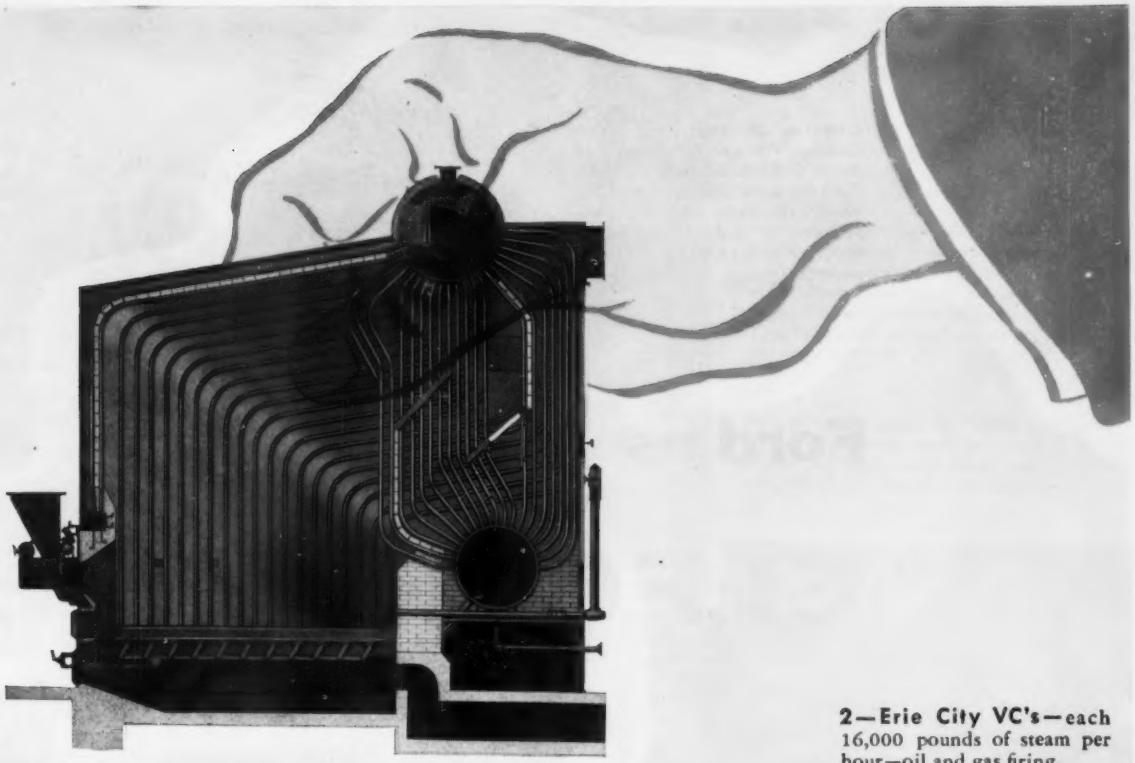
3—Erie City VC's—each 27,000 pounds of steam per hour—oil and gas fired.
A Midwest Capitol Heating Plant



MODERN USE VC's

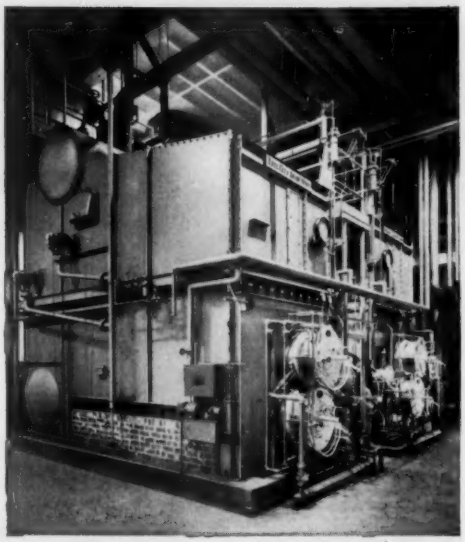
3—Erie City VC's—each 22,000 pounds of steam per hour—oil and gas fired.
A California Institution

4—Erie City VC's—each 33,000 pounds of steam per hour—oil fired.
U. S. Government



POWER PLANTS FOR *Economy*

2—Erie City VC's—each 16,000 pounds of steam per hour—oil and gas firing.
● *A California Hospital*



● **ECONOMY OF INSTALLATION**
Erie City VC's are built in standard sizes and are compact; utilizing every available cubic foot of space either as furnace volume or as space for heat absorbing tubes.

● **ECONOMY OF MAINTENANCE**
These boilers are completely steel encased, have water cooled furnace walls, and ring flow circulation, giving the user a clean, easily maintained boiler room and eliminating costly refractory repairs.

● **ECONOMY OF OPERATION**
Multiple VC installations insure peak efficiency regardless of load condition. Adaptability to all methods of firing permits use of readily available fuels.

Modernize your power plant with the installation of Erie City VC boilers. Moderate steam users everywhere are finding it economical. Bulletin VC-6 gives a full description of the many advantages of this unit.

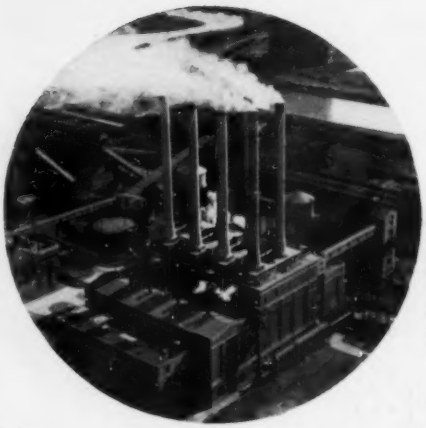
ERIE CITY
114 Years in Steam Generation

You can depend on Erie City for sound engineering

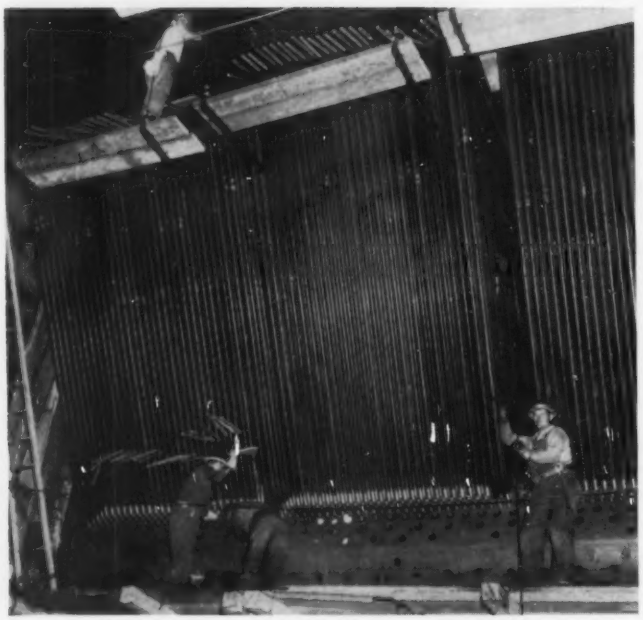
ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

Latest additions to Ford Motor Company's power plant are two drum bent tube twin boilers. Each has 3,948 tubes. Evaporation, 500,000 lbs. steam per hour. Temperature at Superheater outlet 650°F. Pressure at Superheater outlet 250 p.s.i.g.



Ford uses ELECTRUNITE boiler tubes in



This latest boiler installation is part of Ford's continuing modernization program. At the Rouge, which has the largest industrial power plant in the world, Combustion Engineering Inc., is furnishing specially designed boilers.

The ELECTRUNITE Boiler Tubes used are made from high grade steel, made in Republic's own mills. Quality is controlled from ore to finished product through a series of rigid tests and inspections.

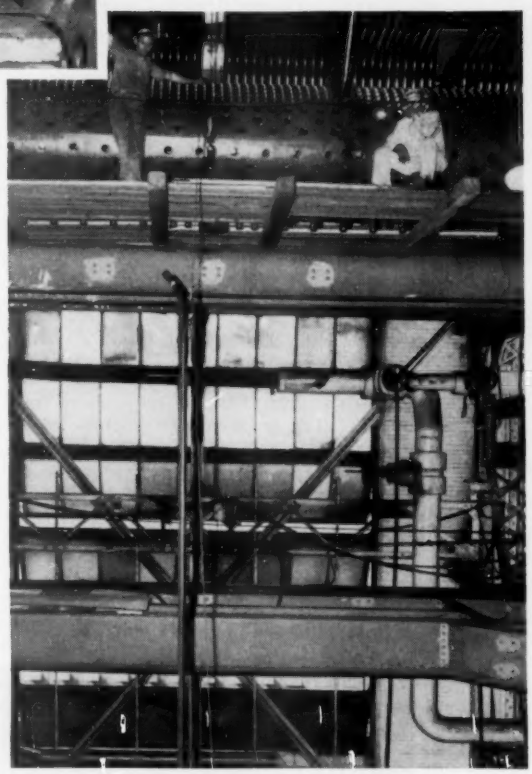
The results: Tubes with uniform wall thickness which give uniform heat transfer all around the tube and from end to end. Uniform ductility for smooth bending and uniform roller-expanding.

Every ELECTRUNITE Boiler Tube has identical metallurgical and physical properties. Because wall thickness is uniform, there are no longitudinal thin spots. This results in uniform heat transfer.

Surfaces of ELECTRUNITE Boiler Tubes are scale-free because they are normalized in a controlled atmosphere. This saves grinding tube ends which destroys uniformity. Tubes slide into drum holes easily, expand uniformly.

●

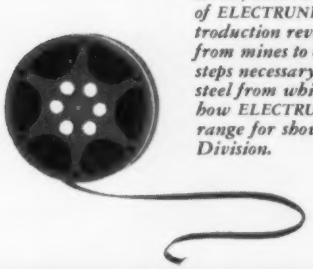
Because of ELECTRUNITE'S uniform ductility, accurate bends are easily made, and spring-back can be calculated before bending operation.



Rouge Plant

From the standpoint of economics, it pays to consider ELECTRUNITE Boiler, Condenser and Heat Exchanger Tubes. Write for the booklet that gives you complete data and specifications.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
221 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York, 17, N. Y.

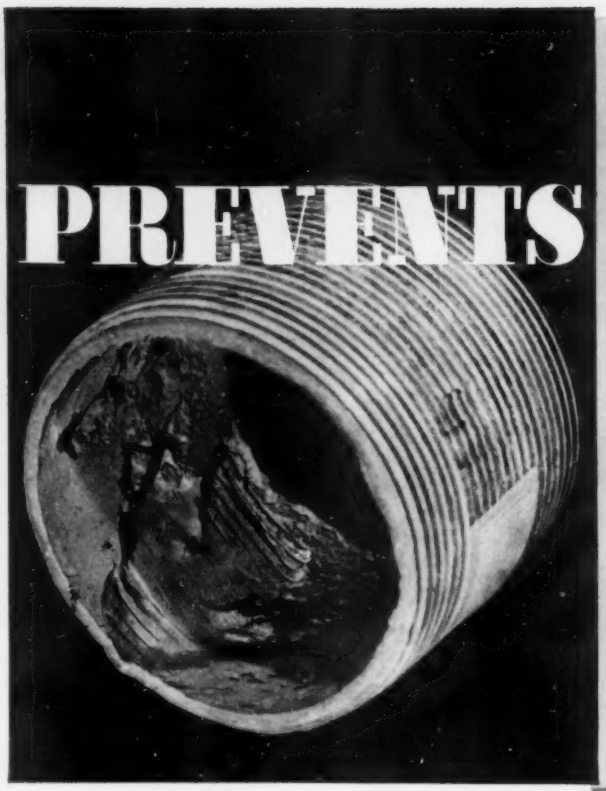


"INTESTINAL FORTITUDE"—16 mm., sound, black and white, 17 minutes. The story of ELECTRUNITE pressure tubes. A short introduction reviews the progress of the iron ore from mines to blast furnace. Then the various steps necessary to make the flat-rolled coils of steel from which the tubing is made. Finally, how ELECTRUNITE tubing is made. To arrange for showing, write to Steel and Tubes Division.

Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Dearborn FILMEEN PREVENTS

TRADEMARK



RETURN LINE CORROSION

You may have seen this many times . . . pipe and fittings eaten through by corrosion. The line must be taken out of service and replaced, causing costly maintenance and production loss.

Dearborn Filmeen* prevents such destruction with a protective film that coats the interior surfaces to prevent corrosion. Minute quantities of Filmeen establish and maintain this protective film throughout the system. Because of its dispersible characteristics, Filmeen will penetrate to every part of the steam and condensate system. Also, Filmeen is non-toxic and, when used as recommended, can be safely applied where steam comes in direct contact with food or where steam is used for sterilization. Write for Bulletin 5013-A. **Pat. No. Re-23614*

Dearborn 659** Sludge Conditioner

The most important development in sludge conditioning is Dearborn Formula 659. This treatment conditions sludge to a fluid, non-adherent form readily removed by blowdown—protects against scale formations in water feeding systems—eliminates corrosion in feedwater systems and boilers. Formula 659, furnished in powder or briquette form, also contains Dearborn's patented Polyamide stabilizing agent which assures high purity steam. Write for Bulletin 5008-B. ***Pat. No. Re-23085*

Untreated sludge **settles into a compact mass causing sludge and scale deposits. Note how sludge adheres to glass.**

Treated sludge **produces fluid, non-adherent particles which readily disperse to prevent packing and attachment.**

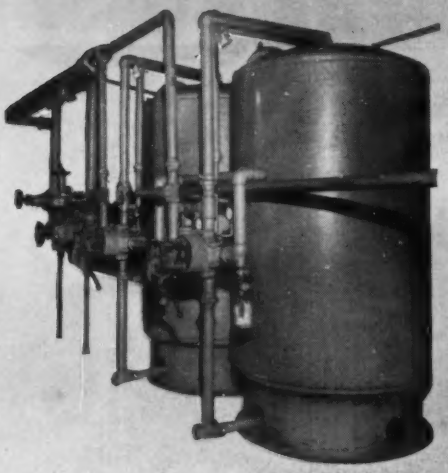
Dearborn

TRADE MARK

COMBATTING CORROSION EVERYWHERE SINCE 1887

DEARBORN CHEMICAL COMPANY · Merchandise Mart Plaza, Chicago 54, Illinois

Dearborn OFFERS A COMPLETE WATER CONDITIONING AND ENGINEERING SERVICE



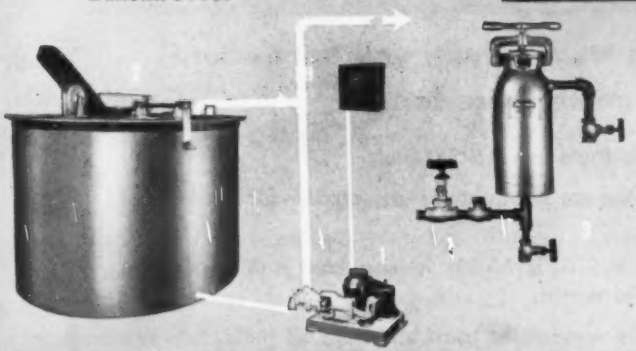
Whether you require a manual, semi-automatic or completely automatic system, Dearborn gives you a customized program including (1) the initial plant survey; (2) external and internal treatment recommendations; (3) properly designed feeding equipment; and (4) supervisory service. Here, from a single source, you have all the facilities for maximum efficiency and economical performance in your water conditioning operations.

ZEOLITE SOFTENERS

A Dearborn installed 500,000-gallon Zeolite water softener for the treatment of boiler water makeup.

DE-IONIZING PLANTS

This Dearborn 2-bed De-Ionizing unit is capable of producing 75,000 gallons of demineralized water per day. Piped throughout with Saran-lined steel. Includes corrosion-resistant ejectors, rubber-lined tanks and valves. On special applications where mineral-free water is required, a Dearborn De-Ionizing plant will reduce the mineral content of water to the equivalent of that produced by evaporation . . . and at a much lower cost. Write for Bulletin 5005.



INTERNAL TREATMENT

(1) High-pressure pump, (2) hand-agitated chemical tank for delivering treatment directly into the boiler drum, (3) Type H feeder for manual application of either briquette or powdered treatments. Write for Bulletin 5000.

why you can rely on *Dearborn*

Dearborn has specialized in the conditioning of water and the control of corrosion since 1887. This broad experience in water treatment and rust prevention—plus Dearborn's extensive laboratory and research facilities—are at your service . . . at no obligation. You'll find it will pay you to . . .

know your *Dearborn* engineer

For LOW-COST UPJOHN burns COAL

UPJOHN'S new pharmaceutical plant which includes units for production of penicillin and cortisone, as well as some 700 other pharmaceutical products, relies on coal for dependable steam.

This ultramodern boiler house supplies steam, cleanly and efficiently, at only 40¢ to 42¢ per 1,000 lbs. It delivers 115,000 lbs. per hour at peak load for the Portage Road Plant near Kalamazoo, Michigan.

There are no dust or smoke nuisances, thanks to the dust collecting and cinder re-injection system.

For both efficiency of operation and economy, you just can't beat coal burned the modern way!

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

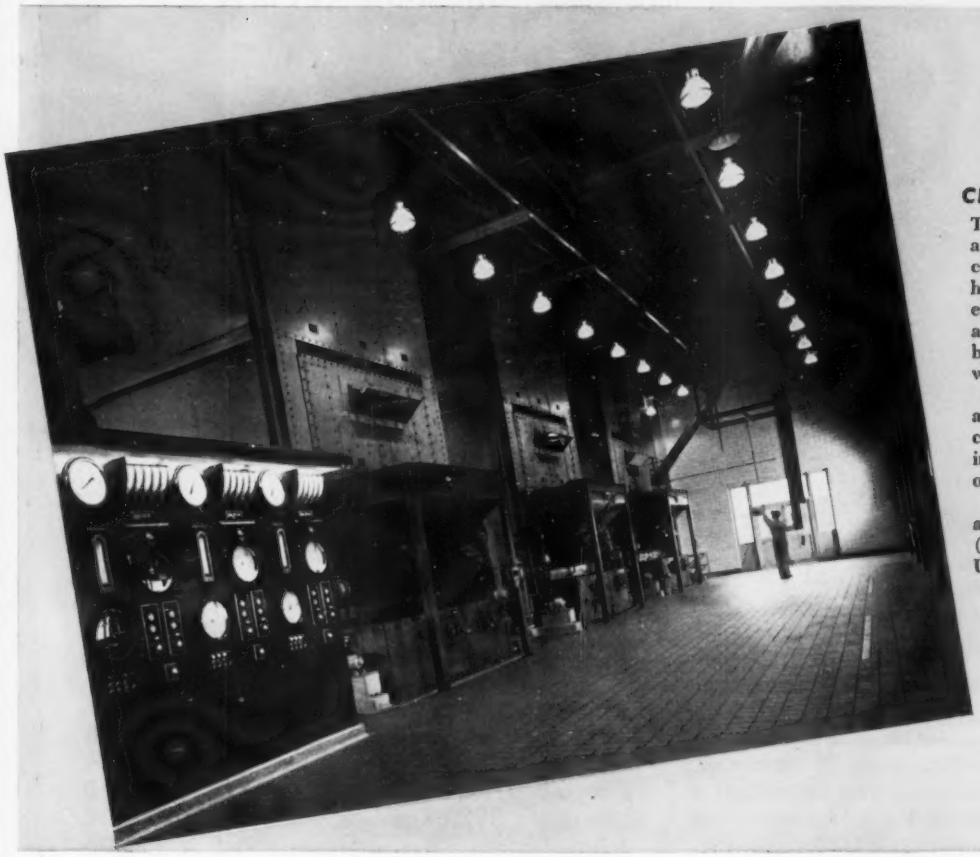
COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

DEPENDABLE steam, the modern way!



CLEAN, CONVENIENT!

This view of Upjohn's firing aisle shows how clean and convenient coal can be when handled and burned the modern way. The stoker hoppers are fed from an overhead bunker. A 2-ton capacity weigh larry serves all boilers.

The ash handling is fully automatic. Traveling grates continually discharge ashes into hoppers below the floor of the firing aisle.

The 3 boilers shown, plus a fourth recently installed (not illustrated), supply all Upjohn's steam needs.

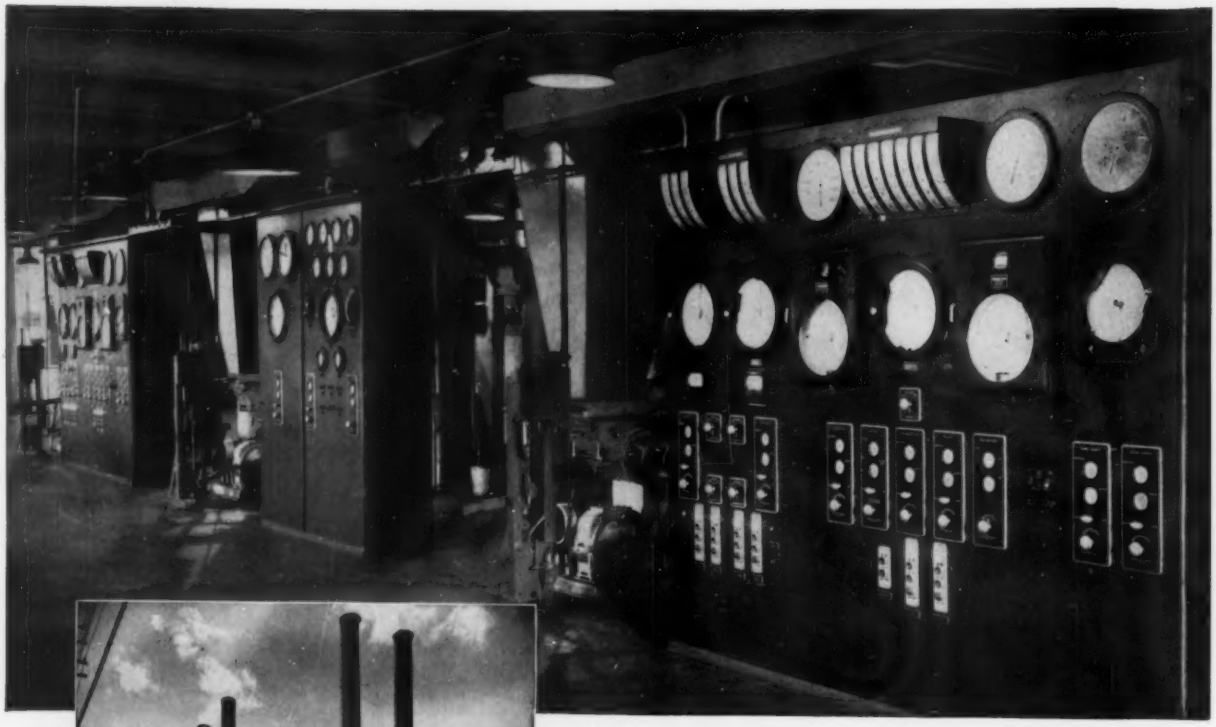
• Whether you're building a new plant or modernizing an older one, you can count on coal for dependability and low-cost operation.

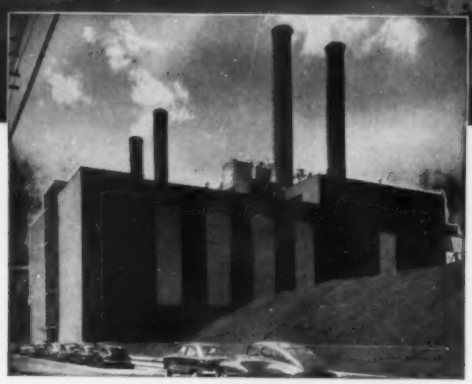
Here's why: Up-to-date coal-burning equipment can give you 10% to 40% more steam per dollar. Automatic coal- and ash-handling systems can cut your labor cost to a minimum. Let a consulting engineer show you how a modern coal installation, tailored for your specific needs, can save you real money.

Here's something else, too—of all fuels, coal alone has virtually inexhaustible resources. This, plus the fact that America's coal industry is the most efficient in the world, assures you of a dependable supply of coal at relatively stable prices now and for years to come.

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!





The Jamestown plant is efficient and modern, inside and out.

Control and

AT JAMESTOWN, NEW YORK MUNICIPAL LIGHT PLANT

REPUBLIC Automatic Combustion Controls Operate Boilers at Test Efficiency to:

SAVE FUEL **by maintaining maximum combustion efficiency continuously.**

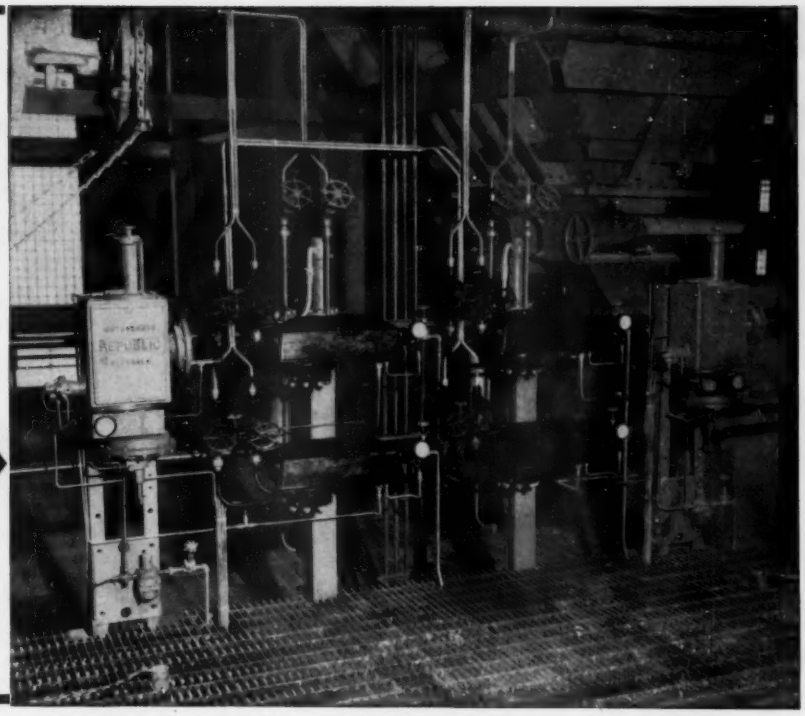
SAVE MAINTENANCE AND EQUIPMENT **by holding uniform operating conditions. Chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation is prevented.**

SAVE MANPOWER **by automatically performing many repetitive adjustments.**

HIGHLY IMPORTANT **during this critical power shortage, the Jamestown plant meets peak load demands because, with REPUBLIC Combustion Controls, it gets all of the steam output the plant boilers are rated for.**

These panels are part of the REPUBLIC Automatic Control System that is used exclusively in the Jamestown plant. When desired, manual operation of the entire boiler system can be made from this location. Panel in the center houses master gauges and other coordinating equipment while panels on either side contain gauges, meters and controls for boilers. REPUBLIC Positioners at left of each panel vary rate of coal feed to pulverizers.

REPUBLIC Regulators and Flow Transmitters are used in the two-element feedwater control system. Rate of feedwater flow to the boiler is changed immediately with a change of either steam flow or feedwater drum level.



Savings are Automatic

At the Jamestown, New York, Municipal Light Plant, two 150,000 lb. per hr. boilers rated at 900 psig. and 900° F.T.T. supply steam to a 20,000 kw turbine. Steam at 275 psig. and 600° F.T.T. is also supplied through a pressure reducing and desuperheater station to an adjoining older plant.

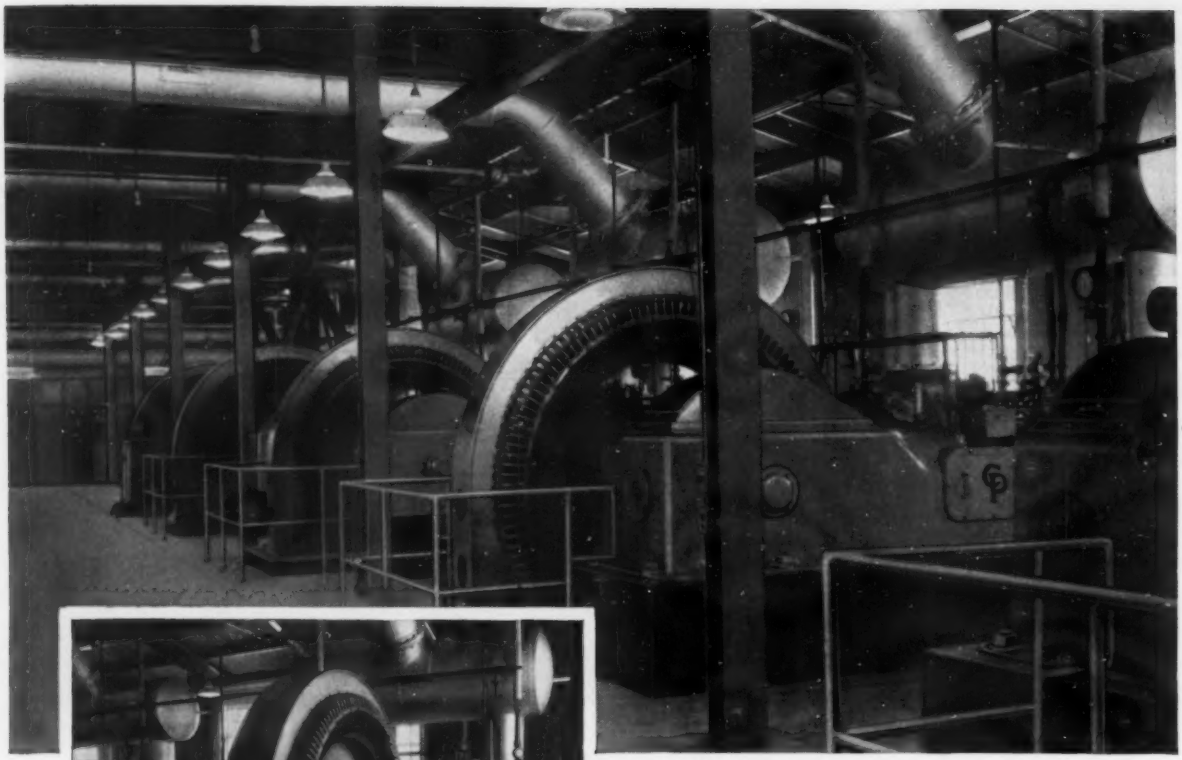
For maximum efficiency and performance, the entire plant is under automatic control. Steam pressure at the turbine is maintained constant and combustion is held at maximum efficiency for steam loads varying from 40,000 lb. per hr. to 165,000 lb. per hr. Both the Automatic Combustion Control System and the pressure reducing and desuperheater station were furnished by REPUBLIC FLOW METERS CO.

ONE OF MANY

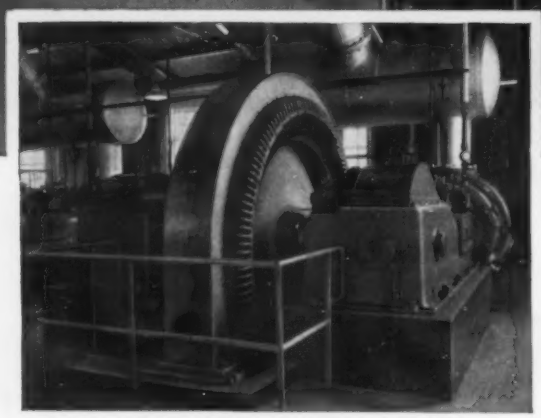
This is but one of many power plants that rely on REPUBLIC Instruments and Controls. For more than 37 years, REPUBLIC has specialized in the design and manufacture of automatic control systems for all sizes of power generating stations. REPUBLIC Controls are available for all types of boilers and auxiliary equipment, all kinds of fuel firing (both for single or multiple fuels) and for all load fluctuations. When you specify REPUBLIC Controls, you get the benefit of this complete line of equipment and the services of an experienced engineering staff who know how to put that equipment to use to give you the control system that best meets your requirements.

For complete information about REPUBLIC Automatic Control Systems, send for Data Book S-21 or contact our field engineer nearest you. There's no cost or obligation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS



Five 1,000 hp Class O-DE compressors installed in a chemical plant.



CP COMPRESSORS

ON TAP 24 HOURS A DAY!

Chicago Pneumatic's heavy duty, Class O Compressors are a prime favorite where 24 hours-a-day service is required.

Engineered for continuous, heavy-duty usage, the Class O affords complete dependability with low operating cost. And they require minimum attention and upkeep. Built in sizes up to 2,000 hp, they're available in single and multi-stage designs, steam and electric drives, for a wide range of pressures. For more information write for Bulletin 726. *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

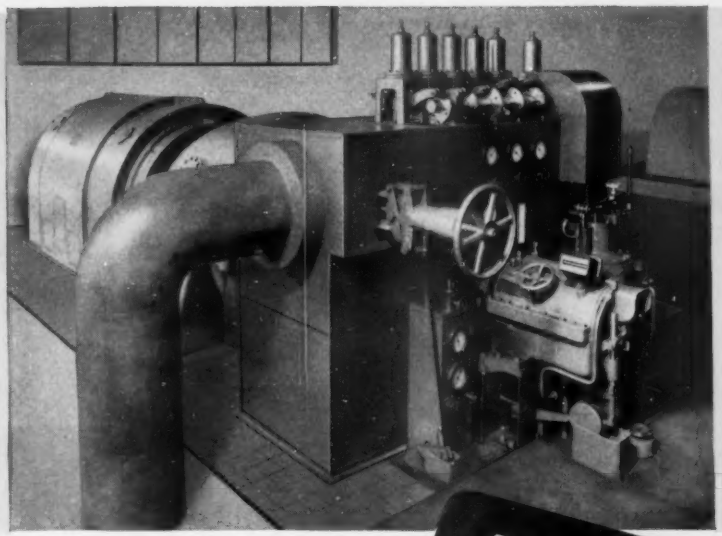
How a Southern Paper Company

Cuts Power Costs Three Ways

1 **Eliminates Tube Failure**

2 **Reduces Maintenance**

3 **Cuts Blowdown Requirements**



Main turbine room contains five turbine-generator units. You can get complete information on silica removal by writing for a copy of Bulletin 28R7135.

In a 33-month period, a southern paper company replaced 133 tubes and welded others. Now, after installation of Allis-Chalmers water conditioning, tube failures have been completely eliminated — along with virtual elimination of unscheduled maintenance. In addition, boilers have operated at top rating and efficiency for 12 months between scheduled cleanings. Blowdown requirements have become approximately half what they were before.

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service

Remove Silica Content in Boiler Water

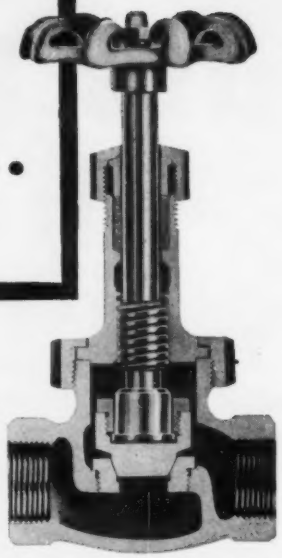
The job was done by reducing silica content 94% through use of a water conditioning system designed by Allis-Chalmers water conditioning experts. Before installation, silica content averaged 43.6 ppm. Now it averages 2.7 ppm. Equipment includes a 24,000-gph hot process softener, three 10-ft *Anthrafilt* filters, a surge tank, and chemical feeder. The system has been improved since original installation by the addition of a secondary hot phosphate unit.

How You Can Solve Your Water Problems

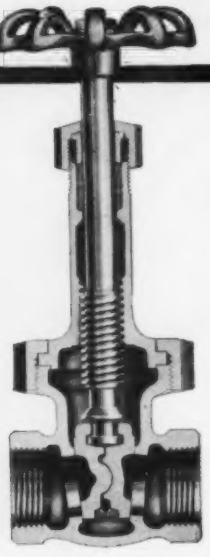
For any water problem, you'll find Allis-Chalmers chemicals, service, and equipment a useful addition to your power or process water application. Years of experience combined with a complete line of equipment enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4200

ALLIS-CHALMERS

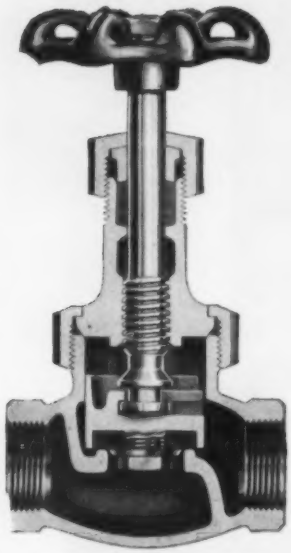
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:

GLOBE

GATE

ANGLE

WALWORTH
valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

CHECK

G-E LIMITAMP controls the operation of high-voltage motor drives up to 2250 hp . . . gives you quick, silent protection for personnel and equipment against dangerous short-circuit conditions up to 250,000 kva . . . helps prevent costly shutdowns.

Safety for your personnel and equipment with high-voltage G-E Limitamp Control

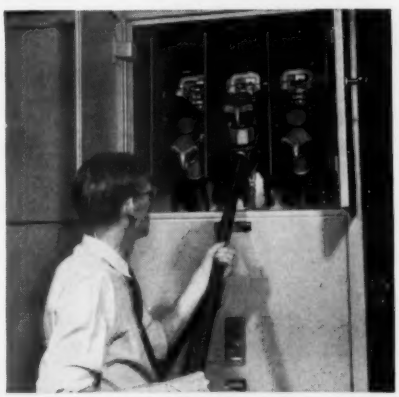
Don't take chances with dangerous short-circuit conditions. G-E Limitamp Control protects against sudden electrical overloads . . . assures greater safety for your personnel and costly electrical equipment. A high-voltage motor control, G-E Limitamp Control provides interrupting capacity up to 250,000 kva.

MAINTENANCE PERSONNEL is guarded by a steel barrier separating high- and low-voltage compartments. A mechanical door interlock assures motor circuit interruption before the fuse compartment door can be opened.

GET EQUIPMENT PROTECTION with General Electric Type EJ-2 fuses which clear fault current in less than $\frac{1}{4}$ cycle, operate only under actual "short" conditions. Also, improved heavy-duty air-break contactors give you millions of operations.

FOR YOUR SPECIAL OPERATION individual components need not be specified. Let G-E application engineers select the correct components, give you the right interrupting capacity . . . better personnel and equipment safety.

FOR COMPLETE INFORMATION about G-E Limitamp Control, contact your nearest G-E Apparatus Sales Office, or write to Section 781-7 for Bulletin GEA-5409 today. General Electric Company, Schenectady 5, N. Y.

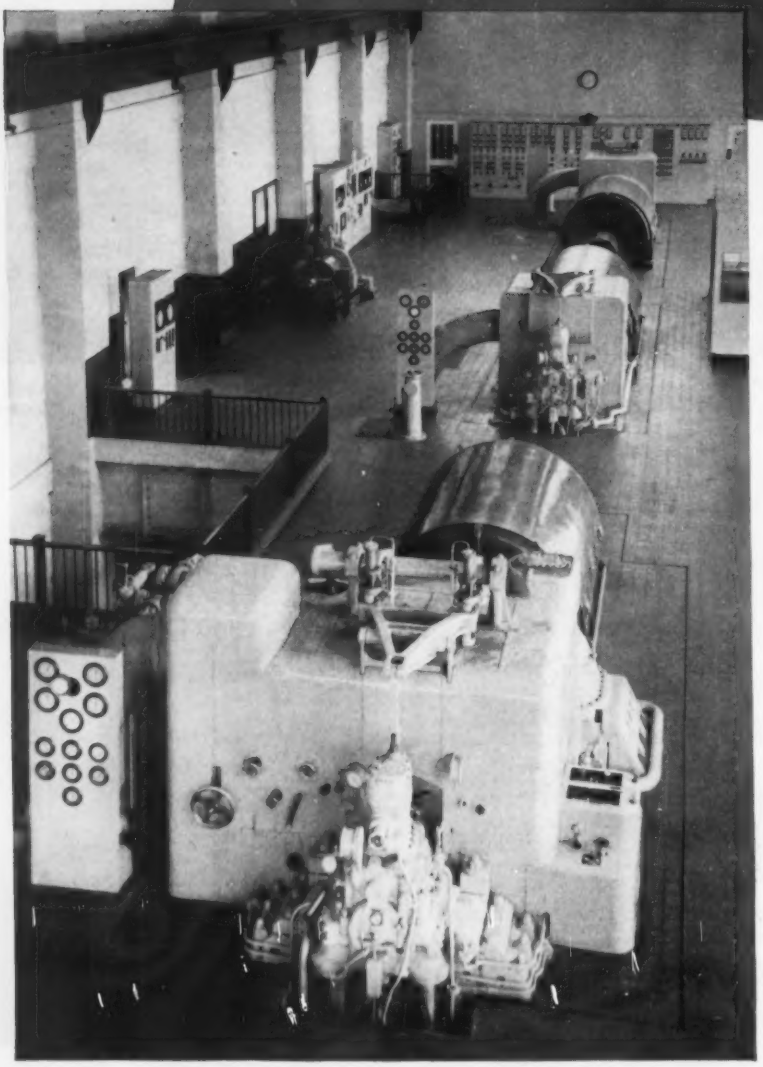


MAINTENANCE IS EASY . . . Fuses swing forward on hinges for the disconnect position and fuses can be quickly lifted out.

You can put your confidence in—

GENERAL ELECTRIC

USE THE OIL THAT ASSURES "ADDED" PROTECTION



TODAY'S DEMANDS for power demand the best in turbine lubrication — *Texaco Regal Oil (R & O)*. This is the oil that has *more than ten times the oxidation resistance of ordinary turbine oils!* It keeps turbine systems free from sludge, rust and foam.

Texaco Regal Oil (R & O) is especially refined from top quality base stocks — then *made even better* by powerful inhibitors of oxidation, rust and foam. This "added" protection means you'll have clean systems, normal bearing temperatures, instant governor response.

There is a complete line of *Texaco Regal Oils (R & O)* for every type and size of turbine. They meet the stringent requirements of all leading turbine builders.

A Texaco Lubrication Engineer will gladly help you improve turbine performance. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R & O)

FOR ALL TURBINES

TUNE IN . . . METROPOLITAN OPERA radio broadcasts every Saturday afternoon. See newspaper for time and station.

'Hospital Plants Need a Doctor'

LONG AGO I stood up at a convention of the American Hospital Association and talked turkey about the terrible state of the power-service equipment in the average hospital. I blamed conditions on penny-wise, dollar-foolish management, and told the association that "hospital plants need a doctor."

A letter just received from a harassed chief engineer suggests that conditions haven't improved much in the intervening years. It seems that the average hospital engineer is still the forgotten man—that he is still fighting to keep his plant's body and soul together despite worn-out, obsolete equipment, a vast shortage of instruments and other efficiency devices, too little money for upkeep and, finally, no chance to pay enough to hold good help.

In this typical hospital plant, steam-line insulation hangs in shreds while the frantic maintenance crew sloshes around in basement puddles, dodging steam leaks. Behind the pretty white-tiled walls, which shield patients and visitors from engineering realities, the "works" are a shambles.

The engineer who wrote to me hangs on, partly from loyalty and partly because he "hopes things will be better some day." Yet his plea is heart rending: "My orders are to keep maintenance down, keep this place going, keep steam pressure up, keep water pressure up, keep the elevators running 24 hours a day, *and cut out overtime*—all this with second-rate human material, rotten pipes, poor water pressure and punk wiring.

"At the department-head meetings I tell my director all this and ask for just four decent, loyal men. That's all, and I will do the rest. But you know how it is—'budget does not permit'—'trained help costs money'—'hospitals don't make money.' That's what I get at the meetings. Phil, if you rip the lid off this, we are all for you."

OK, here goes! What grieves me most about this kind of "economy" is that it's all based on a terrible misunderstanding—the idea that every dollar spent for plant instruments, or steam-pipe insulation, is one dollar less available for medical services. This tragic confusion persists from coast to coast among many hospital superintendents and, even more, among the well-meaning board members, who have so much to say about getting and saving money.

These responsible people are entirely correct when they complain of the shortage of money in most hospitals. But let me ask why a shortage of money should be made the excuse for wasting it? That's what's happening. Money is needed for a new X-ray machine or electrocardiograph, so they say they can't afford that water meter or that insulation repair job. And soon the continuing waste in water and fuel bills costs a lot more than the meter and insulation would have.

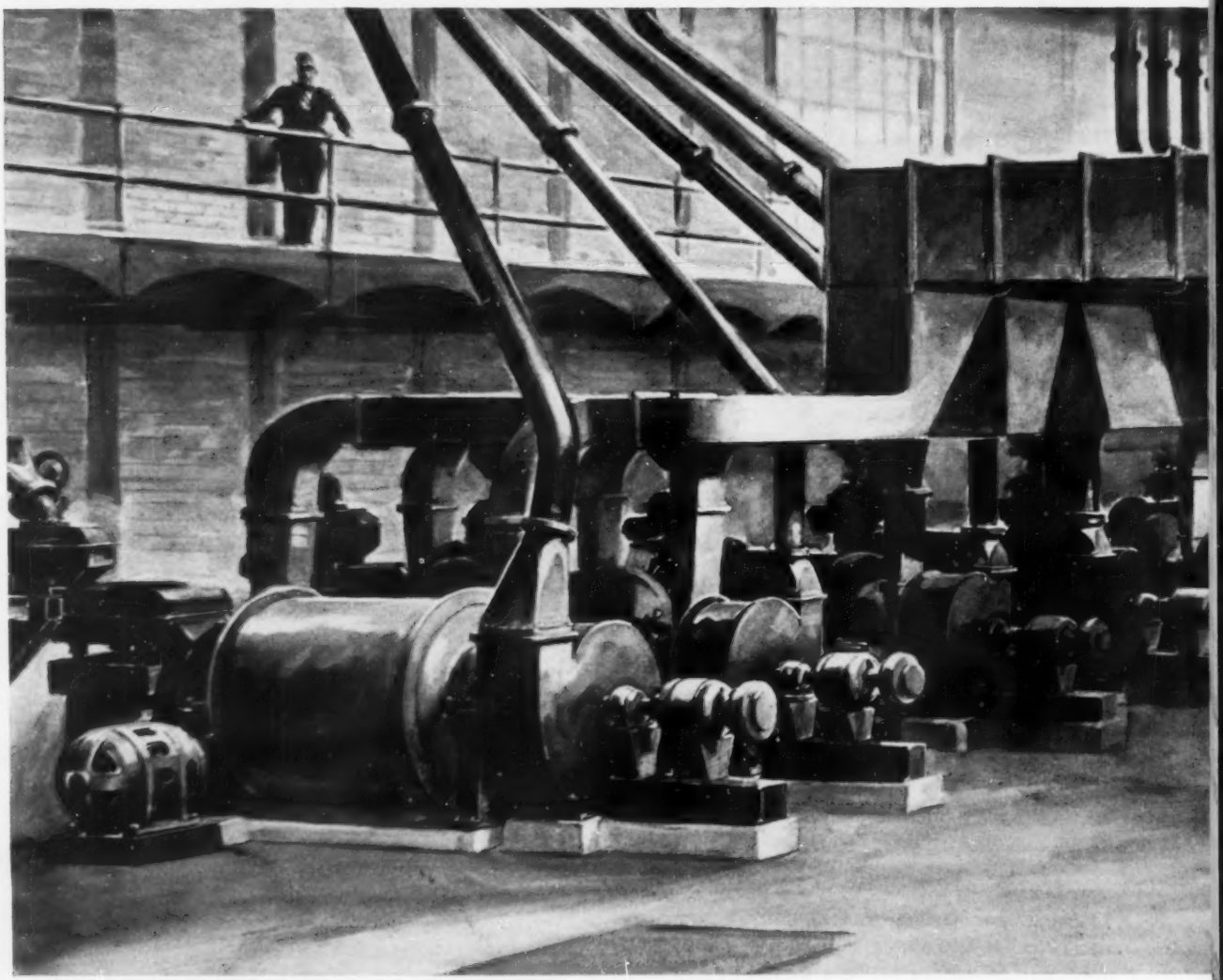
This kind of "economy" in the engineer's department doesn't help hospitals get needed medical and surgical equipment. It does just the opposite.

Let's put it this way, bluntly: From coast to coast, with certain notable, shining exceptions, badly confused hospital directors and managers are saving pennies in deferred upkeep and modernization while pouring dollars down the drain in excessive monthly bills for fuel, electricity, water and other services.

And so, with all good will toward these great institutions dedicated to human welfare, I must repeat my charge of years ago, "Hospital plants need a doctor."—PWS

25 YEARS OF

with KENNEDY coal firing equipment!



15 KVS AIR SWEPT TUBE MILLS ON AN EASTERN CENTRAL SYSTEM.

OVER A QUARTER-CENTURY OF CONTINUOUS SERVICE WITHOUT REPLACEMENT OF ANY GEARS!

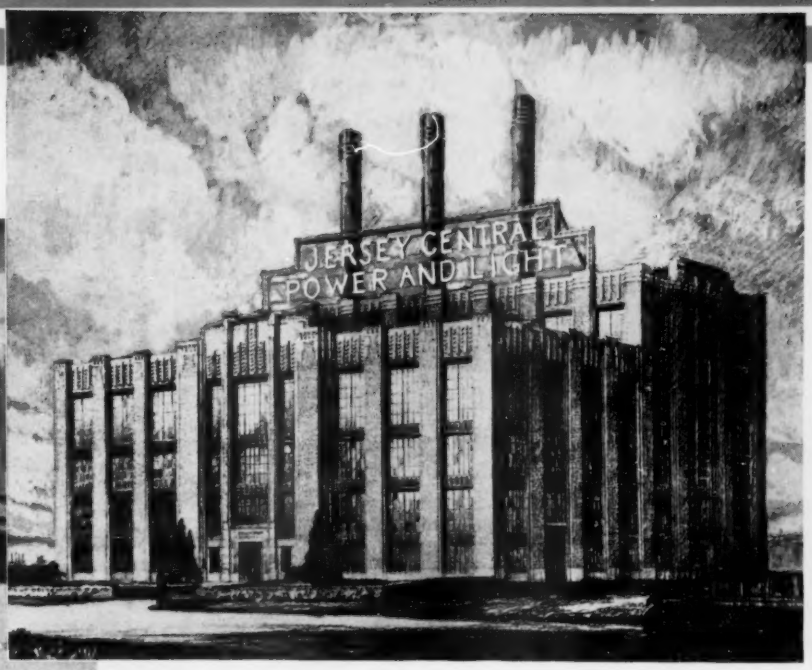
Here's an outstanding service record, typical of all KVS installations, that demonstrates the quality of materials and workmanship used in manufacturing Kennedy pulverized coal burning equipment. No other manufacturer can match this record.

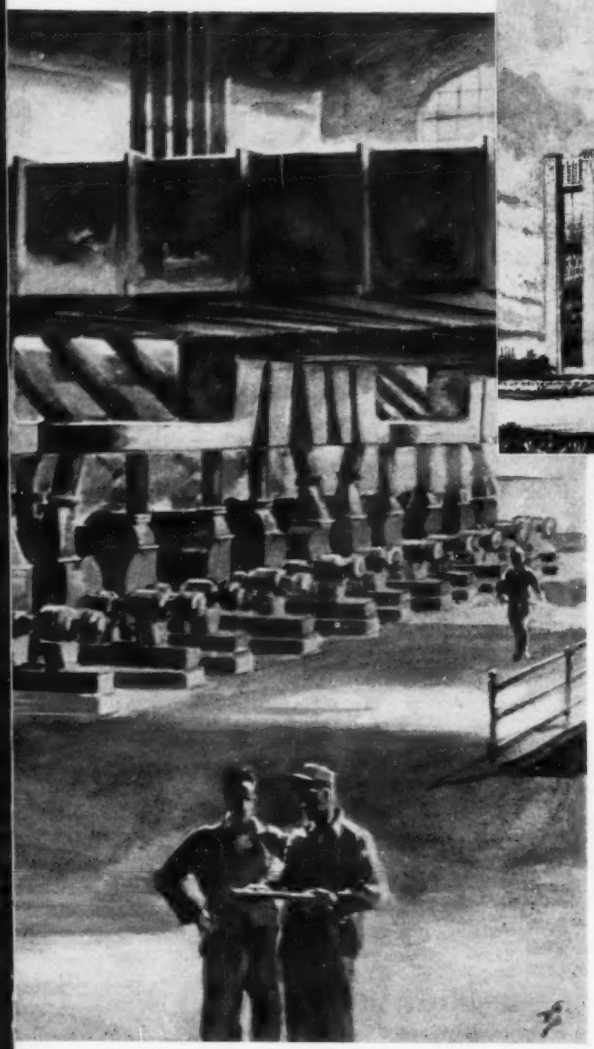
In this plant, three boilers each generating 300,000 lbs. of steam per hour at 1400 lbs. pressure, are fired by 15 KVS worm drive Air Swept Tube Mills in line. A unique feature of the installation is that each boiler is fired by five pulverizers, each with its own burner, providing a highly flexible steam generating plant with instant response to combustion controls.

With the KVS system, coal firing is instantaneous, combustion complete. Any grade of coal . . . from cheapest to finest . . . can be burned. Tremendous savings, *often exceeding $1.00 per ton* can be realized.

No other system produces comparable results. If you are interested in cutting *your* coal costs, let our engineering department make an analysis of your plant. The KVS coal firing system obtains maximum heat value from every ton of coal burned!

DEPENDABLE SERVICE





FEATURES OF THE KVS PULVERIZED COAL FIRING SYSTEM

- FULLY AIR SWEPT
- COAL PULVERIZED TO SUPERFINENESS
- COAL COMPLETELY CARBURETED Ready for combustion
- BIG TRUNNIONS FOR AIR SWEEPING
- BALLS ADDED WITHOUT SHUTTING DOWN
- LOW OPERATING AND MANTENANCE COSTS
- UNBURNT CARBON LOSSES LESS THAN ½%
- INSTANT RESPONSE TO CONTROLS
- 85% TO 90% THROUGH 200 MESH
- 20% MOISTURE REMOVED WHILE PULVERIZING
- PULVERIZES ANY COAL BITUMINOUS, ANTHRACITE, COKE BREEZE
- TRAMP IRON ACTUALLY AIDS IN PULVERIZING
- RESERVES OF FUEL FOR INSTANT RESPONSE AND STEAM DEMAND

GET THE FACTS ON THE KVS COAL FIRING SYSTEM!

IT COSTS LESS... TO OWN THE BEST!

KENNEDY - VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

TWO PARK AVENUE, NEW YORK

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fabricated and erected by Blaw-Knox

high pressure crossover piping

. . . in large power plant

To get more information on piping for industry write for your copy of Bulletin No. 2443.

Whether you need a complicated, high pressure piping system, such as this one, or a relatively simple job, you can always turn the entire job over to us. And we'll follow through . . . in close cooperation, of course, with your consultants or your own organization.

You'll get the benefit of modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory which assures you of the latest developments in high pressure, high temperature piping. The most modern testing equipment to assure the soundness and strength of the piping.

Plus a complete service force with modern machinery for field work and erection . . . and the necessary manpower to handle jobs of any size.

What service do you require?

We will, for instance, (1) engineer, fabricate, and erect your job . . . or (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, when desired, make a field study of your piping requirements before quoting.

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Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

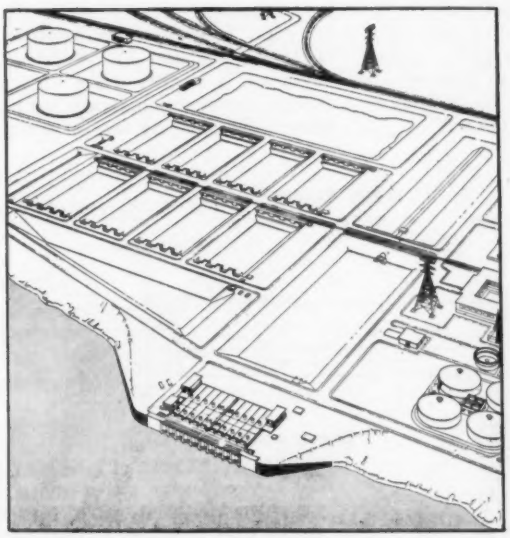
Power
MARCH 1954

Pump station today

Mammoth water-supply and wastes-treatment facilities prove that...

Ably Engineered Water Services Pay Big Dividends

By **ROSS NEBOLSINE**, *President*, **ANGUS D HENDERSON**, *Vice-President*,
and **HUGH MacDOUGALL**, *Chief Engineer*, *Hydrotechnic Corporation*



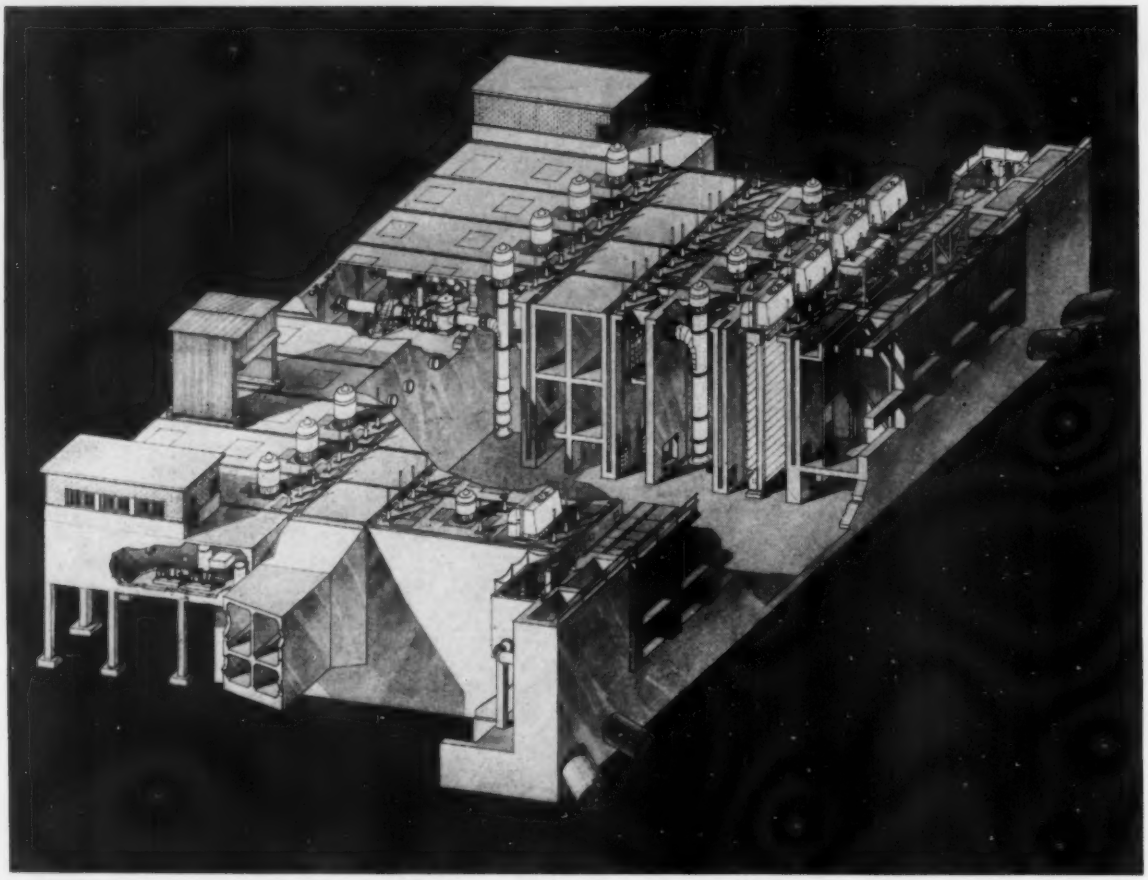
Perspective view

► CONTINUITY OF SERVICE — that was the chief concern of U.S. Steel when directing design of the 250-mgd industrial water supply for huge Fairless Works in Morrisville, Pa.

Any complete shutdown of water delivery meant a full-scale and extremely costly stoppage in steel making. So four steps were taken to assure water for at least a minimum operation that would prevent damage to mill equipment.

Design Features. Aerial views on this page and diagrams on p 70 show many details of the big water-supply facilities. The cellular pumping-plant structure permits removal and repair of any in-

More on next page ▶

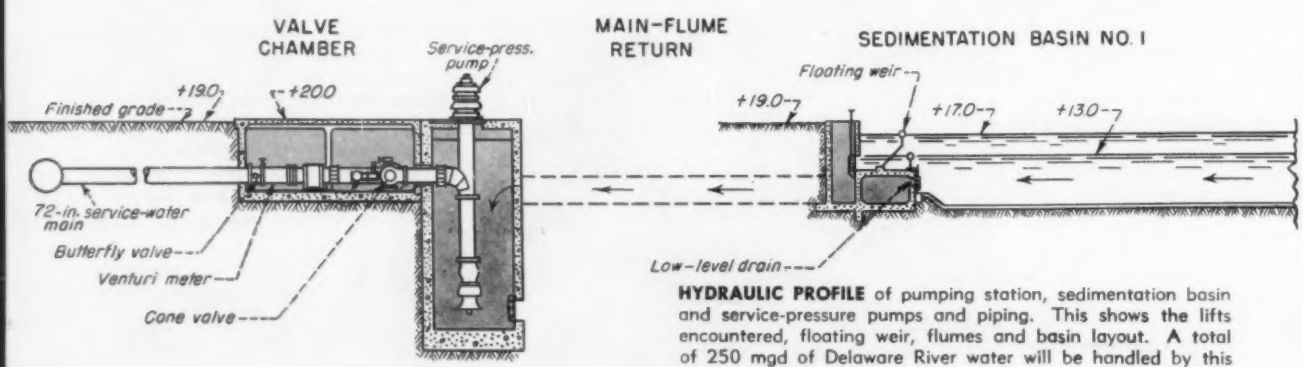


ISOMETRIC VIEW of patented river pumping station for the Fairless Works of U.S. Steel. Water enters rectangular intakes, passing through bar racks and screens to the low-lift pumps. Flumes and service pumps are located behind the low-lift units

dividual pump or other unit without interrupting service. A 13-mg settling basin doubles as water-storage space to give time needed to start emergency pumps during a power failure.

To maintain continuity of electric-power service the 60,000-kw steam plant at the works has a power-line tie with Philadelphia Electric. Lastly, in an emergency a pair of steam-driven 70-mgd pumps in the power plant can take over to draw water through power station's discharge line and deliver it to sustain minimum operation throughout the mill.

Water Supply. Service water is drawn from the Delaware River by low-lift pumps and discharged into the upper channels of the main flumes. Low-lift vertical turbine pumps will have a capacity of 285 mgd. High-lift pumps discharge 134 mgd. From the main flume the water flows by gravity to the sedimentation basins, *below*. After passing through the basins, a portion of the water goes to the powerhouse through the circulating-water tunnel. Remaining water returns to the pumping station through the lower channels of



HYDRAULIC PROFILE of pumping station, sedimentation basin and service-pressure pumps and piping. This shows the lifts encountered, floating weir, flumes and basin layout. A total of 250 mgd of Delaware River water will be handled by this

Flexibility and versatility are outstanding features of this large pumping plant

the main flume. Here the service pumps discharge it through cone valves and venturi meters into the service-water system, diagram, *bottom of p 70*.

Pumping station consists of five similar bays. It has four 55,000-gpm and two 18,000-gpm low-lift single-stage propeller-type pumps. They all discharge through flap valves 7 ft below the base plates. There are six service-pressure pumps —four are 2-stage vertical turbine-type 20,000-gpm units; two are 3-stage 6000-gpm units. These six pumps discharge through cone valves 10 ft below the base plates.

No Superstructure. Pumping plant is reinforced concrete, entirely below grade. Operating-floor level, diagram, *top of p 70*, is just a foot above grade. No superstructure shelters motors, screen drive or lift cranes, which ride tracks over the gates and trash racks.

Only semblance of a superstructure is the shed enclosing the 20-ton traveling gantry crane, installed for maintenance removal of any one of the station's 12 pumping units. Shed is a steel-framed structure with corrugated sheet-steel walls and roof. Rolling doors at both ends permit entrance to the shed and allow crane to straddle equipment hoisted.

Shed is caster-mounted with double-flanged track-riding wheels. Tracks have a 16-ft gage, and shed can be moved manually or by a rubber-tired tractor. Manually operated turntables permit moving shed longitudinally or transversely across the operating floor. Gantry-crane hook is 15 ft above floor—high enough to hoist any pump in the plant.

Floating Basin Controls. The 13-mg 4-compartment clarification basin, through which all steel-mill service and cooling water passes, is a 600x250x13-ft reinforced-concrete structure. To assure proper skimming at various water levels, there is a floating weir on the basin. It permits operation through a 5-ft fluctuation of water level.

Besides clarifying the service-water supply, this settling basin provides emergency storage for mill water. Up to 5 mg is figured usable as a cushion during a power failure. Enough water will be fed the mill to prevent its shutdown during the time the steam-powered pumps are being started. Then these auxiliary pumps can supply 70 mgd as long as needed. The blast and open-hearth furnaces and coke plant are well protected by this auxiliary supply.

Pipe Materials. Service-water pipes are wrapped welded steel where size is less than 20 in. Larger lines are reinforced concrete or prestressed concrete except at bends and major connections where they are steel with a protective wrapping.

Potable water is distributed in cast-iron pipe. The supply comes from a Ranney water collector rated at 5 mgd. It is driven to a depth of about 50 ft near the Delaware River. Two other ground collectors with an estimated total yield of 20 mgd supply special process water for rolling and plating operations. Its quality must be higher than that of river water handled by the pumping station.

Water Treatment. Chlorine can be added to water in both the cooling- and service-water systems to prevent slime growth. Chlorination is program-controlled to intermittently feed quantities proportional to water flow.

If desired, clarified waste water can be recirculated from the terminal plant, pp 72, 73. After treatment, effluent from this plant can be stored in a central lagoon. From here it can be returned to the river pumping station and pumped into the service-water system.

Where sedimentation is not needed, the low-lift pumps can be bypassed and the water taken directly into the service pressure pumps. Low-level intakes are fitted so water can be drawn from river even during periods of extreme low water.

Pump Protection. Racks made of vertical steel bars spaced on 3½-in. centers protect the inlet to each pump bay. Rack sections are easily withdrawn from their guides by means of a lifting beam.

A rake, made of a heavy angle frame fitted with rollers, has teeth projecting into the rack bar spaces. When hoisted the rake scrapes trash off the rack.

Traveling water screens behind the racks remove any trash that may have passed through. It is probable that these screens will be needed only during seasons when leaves, algae and fish appear in unusual quantities in the water. When this happens the screens are started automatically when the loss of head through them reaches a predetermined maximum.

Waste Treatment. Flow diagram on pp 72, 73 shows the major components installed at Fairless Works for treating wastes from various process operations, and from the power plant. Probably never before has a single industrial-wastes picture of such completeness been drawn up in advance for an industrial plant of such scale.

The diagram depicts what wastes issue from each separate source within the vast steel works. It also shows how each of these wastes will be handled.

Hydrotechnic Corp, of New York, was retained by U.S. Steel for the design of all potable and industrial water supplies, drainage, sewage and industrial-wastes facilities for Fairless Works. In all cases this work started and ended at building lines, U.S. Steel engineering all indoor piping, pumping, etc.

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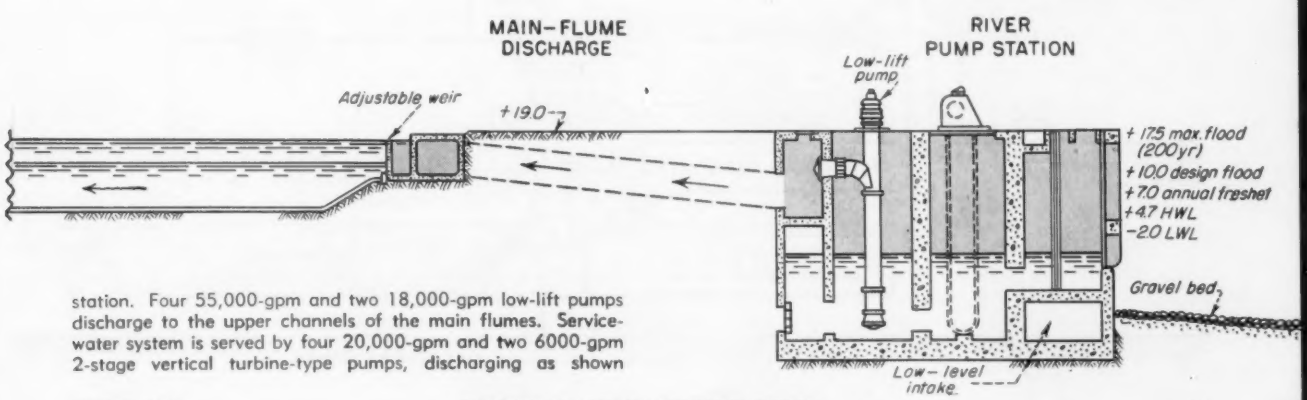
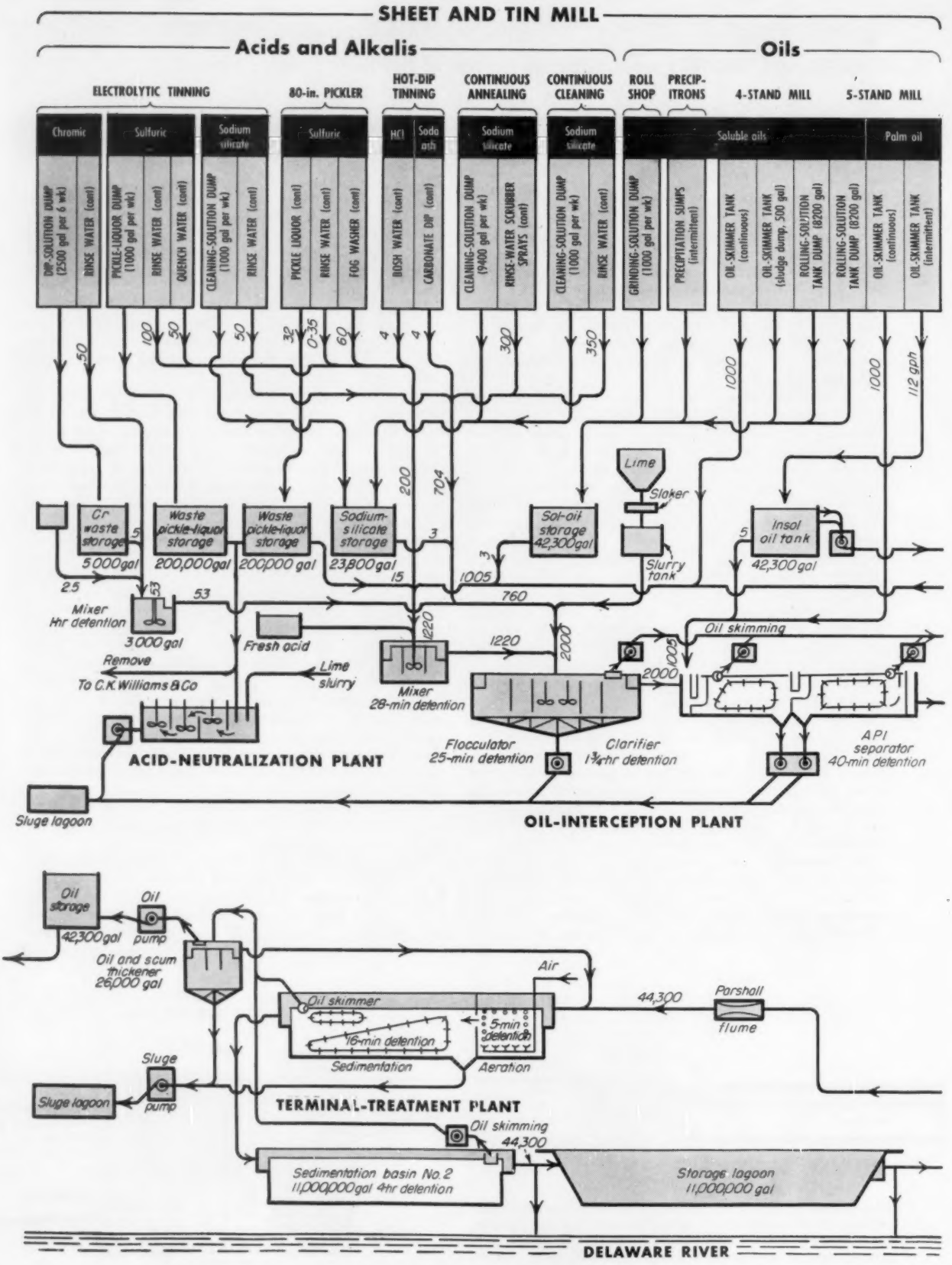
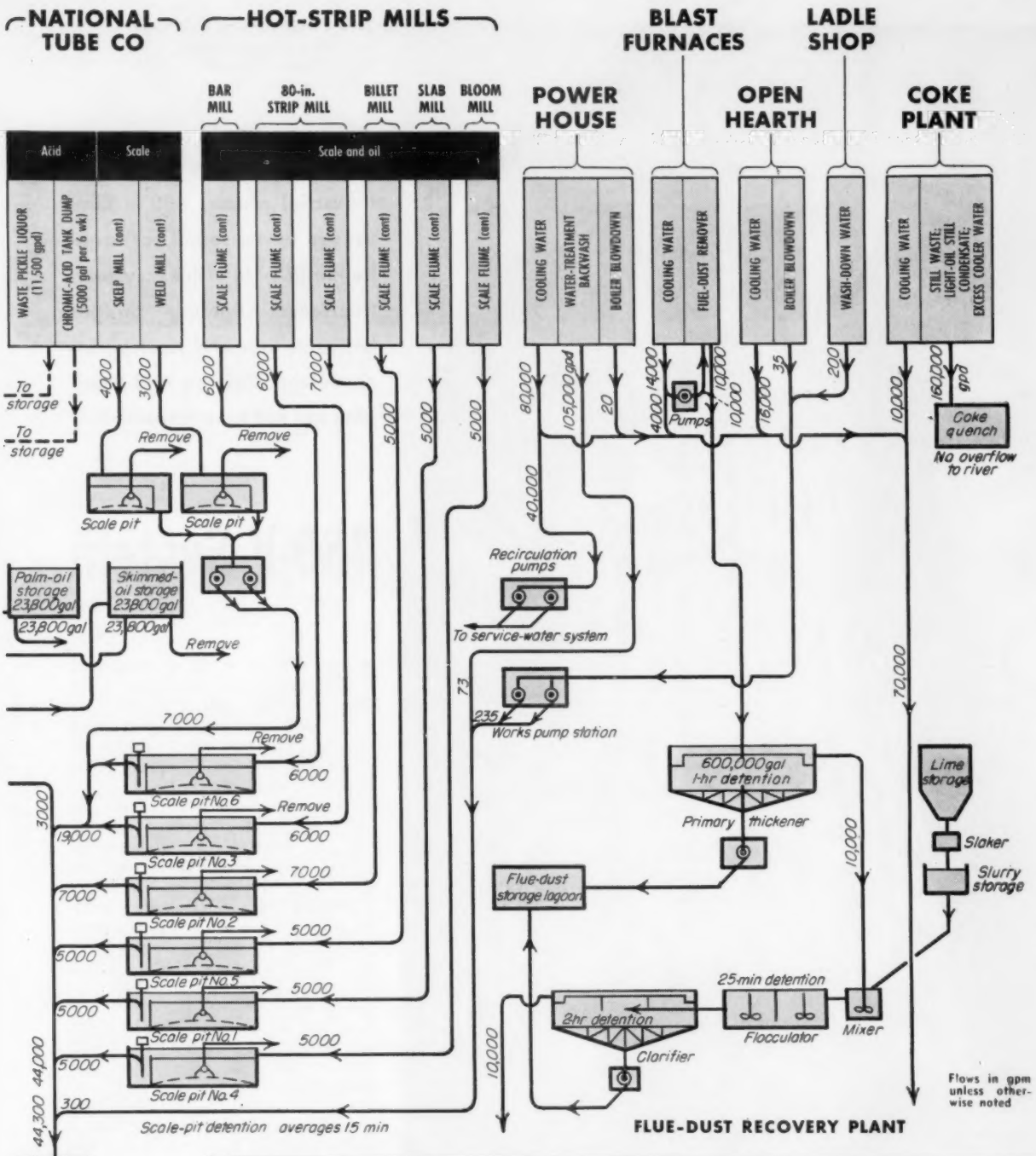


station. Four 55,000-gpm and two 18,000-gpm low-lift pumps discharge to the upper channels of the main flumes. Service-water system is served by four 20,000-gpm and two 6000-gpm 2-stage vertical turbine-type pumps, discharging as shown


SHEET AND TIN MILL
Acids and Alkalis
Oils
ELECTROLYTIC TINNING
80-in. PICKLER
HOT-DIP TINNING
CONTINUOUS ANNEALING
CONTINUOUS CLEANING
ROLL SHOP
PRECIP-ITRONS
4-STAND MILL
5-STAND MILL
Chromic
Sulfuric
Sodium silicate
Sulfuric
HCl
Soda ash
Sodium silicate
Sodium silicate
Soluble oils
Palm oil
DIP-SOLUTION DUMP (2500 gal per 6 wk)
RINSE WATER (cont)
PICKLE-LIQUOR DUMP (1000 gal per wk)
RINSE WATER (cont)
QUENCH WATER (cont)
CLEANING-SOLUTION DUMP (1000 gal per wk)
RINSE WATER (cont)
PICKLE LIQUOR (cont)
RINSE WATER (cont)
FOG WASHER (cont)
BOSH WATER (cont)
CARBONATE DIP (cont)
CLEANING-SOLUTION DUMP (9400 gal per wk)
RINSE-WATER SCRUBBER SPRAYS (cont)
CLEANING-SOLUTION DUMP (1000 gal per wk)
RINSE WATER (cont)
GRINDING-SOLUTION DUMP (1000 gal per wk)
PRECIPITATION SUMPS (intermittent)
OIL-SKIMMER TANK (continuous)
OIL-SKIMMER TANK (sludge dump, 500 gal)
ROLLING-SOLUTION TANK DUMP (8200 gal)
ROLLING-SOLUTION TANK DUMP (8200 gal)
OIL-SKIMMER TANK (continuous)
OIL-SKIMMER TANK (intermittent)
50
100
50
50
32
0-35
60
4
4
300
350
1000
1000
112 gph
200
704
Lime
Slaker
Cr waste storage
5,000 gal
Waste pickle-liquor storage
200,000 gal
Waste pickle-liquor storage
200,000 gal
Sodium-silicate storage
23,800 gal
Sol-oil storage 42,300 gal
Slurry tank
Insol oil tank
42,300 gal
25
53
53
Mixer
Hr detention
3,000 gal
Fresh acid
Remove
To C.K. Williams & Co
Lime slurry
1220
1220
2000
760
1005
Mixer
28-min detention
Oil skimming
2000
ACID-NEUTRALIZATION PLANT
Flocculator
25-min detention
Clarifier
1¾ hr detention
A.P.I. separator
40-min detention
Sluge lagoon
OIL-INTERCEPTION PLANT
Oil storage
42,300 gal
Oil pump
Oil and scum thickener 26,000 gal
Air
Oil skimmer
16-min detention
5-min detention
Sedimentation
Aeration
44,300
Parshall flume
Sluge
Sluge lagoon
pump
TERMINAL-TREATMENT PLANT
Oil skimming
44,300
Sedimentation basin No. 2
11,000,000 gal 4hr detention
Storage lagoon
11,000,000 gal
DELAWARE RIVER



How 43 Wastes Are Treated by U.S. Steel

For any given waste, trace its flow from top to bottom of chart. This shows how used industrial water is stripped of reclaimables and also rid of wastes.

At the bottom, after treatment, the water is ready for recirculation or return to the Delaware. Water returned to river is purer than that taken out. Flows and arrangement shown were used in preliminary design and do not show exact final conditions or hookup.

U.S. Steel will actually increase low-stage flow of river at this point (below Trenton, N.J.). It will discharge about 20 mgd drawn from ground waters, besides the 250 mgd drawn from and returned to the stream (less evaporation and other minor losses).

By D L BEEMAN and H D KURT
Industrial Engineering Section
General Electric Company

After making heavy inroads in industrial plants, 480 v now shapes up as sound for large buildings. In this system, fluorescent lighting bridges between line and neutral; incandescent lighting and small load are fed from transformers

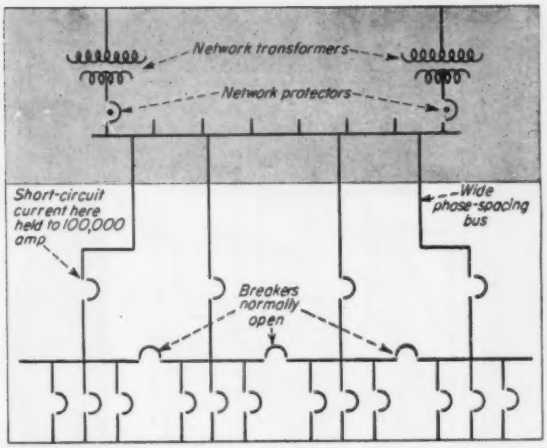
480-V System

LARGE OFFICE BUILDINGS with their spiraling loads are fast becoming prime candidates for higher voltage distribution to supersede present 208Y/120-v system

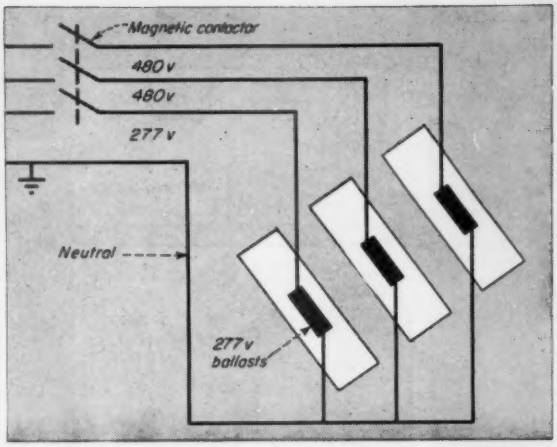
► THE MODERN OFFICE or commercial building has a load characteristic much like an industrial plant. There is a large motor load—air-conditioning compressors, fans, elevators, pumps—which can be economically served at voltage higher than the 208 widely used now. If we think in terms of a 480-v system, the heavy general-area fluorescent lighting can be operated off line-to-neutral voltage using higher-voltage ballasts (POWER, October 1953, pp 122-123).

Building Loads. Today's office-building loads run about 2 to 5 volt-amperes per sq ft for general area lighting, 2 to 5 va per sq ft for power load, ½ to 2 for miscellaneous loads, business machines, water coolers, appliances, etc. Total load in yesterday's office buildings was but 1½ va per sq ft. Marked load increase makes the 480-v system particularly appealing for larger buildings. Minimum-size building, at which 480 v becomes economical, may range from a few hundred to a few thousand kva. Determining factors are often availability of the higher-voltage power supply, type load, building configuration.

All components carrying the Underwriters' listing are now available for a complete 480-v system with 277-v fluorescent lighting. These include incoming-line switching equipment, cable and bus risers, panel boards, dry-type transformers for 480 to 120/240 v, remote-control branch-circuit-switching system or wall switches rated to 300 v, higher-voltage



TYPICAL SERVICE with section ties. To prevent available amps mounting, close a tie breaker only if one feeder is dead



FLUORESCENT LIGHTING in large open areas can be fed through contactor, tapping load between phases and neutral

Makes Strong Bid for Office Buildings

ballasts for fluorescent lamps. For incandescent lighting it is generally better to use 120-v lamps operated from stepdown transformers.

Which Voltage? The EEI-NEMA designation for the higher voltage system is 480Y/277 v. Actually this refers to a system having a voltage spread from 420 to 480, with the latter the maximum. Many engineers prefer to rate such a system 460Y/265 v, which is all well and good. The important point to remember is that 460Y/265 and 480Y/277 are different names for the same system.

Dropping from 480 to 120 calls for stepdown dry-type transformers. And some load in every office building must operate at 120 — or should serious thought be given to getting business machines, incandescent lamps, fans, electric razors, etc, rated for 265 v? Most of this miscellaneous equipment is designed for use on 120-v systems, and rightly so. Much is portable, and may belong to and be moved by tenants from one building to another. So adoption of 265-v equipment would prevent interchanging. There is also the matter of safety, particularly in small, portable devices.

If a new line of fractional-hp motors and appliances is requested for 265 v (POWER, October 1953, p 124) the resulting cost will be out of line in proportion to benefits. The high cost would come about since at best production would amount to 1% of those in the 115- and 230-v class.

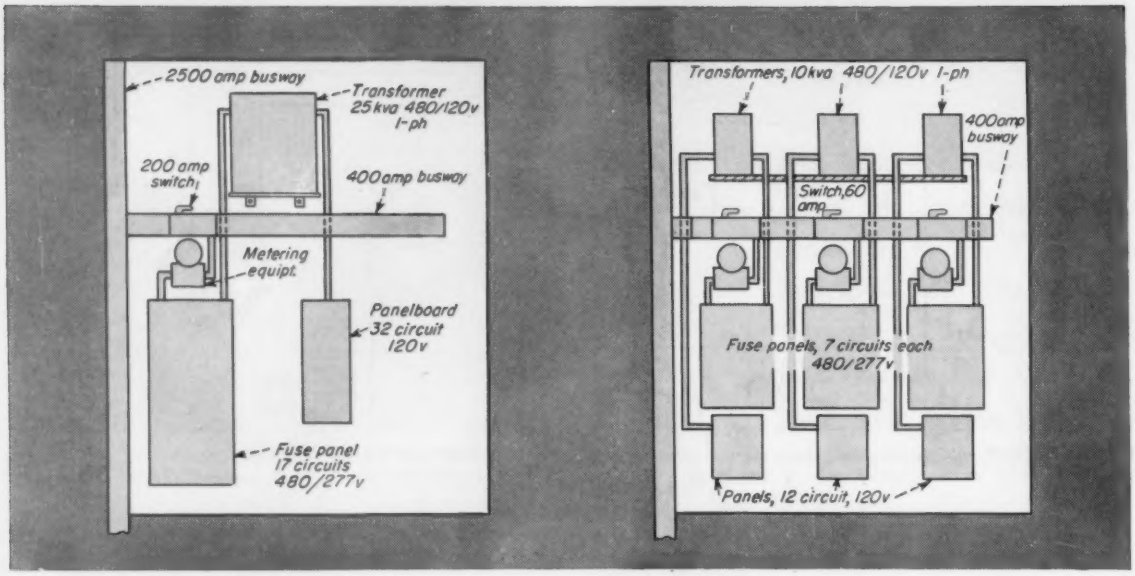
Supplying 120 v through dry-type transformers, even where the miscellaneous load amounts to 5 va per sq ft, is generally economically sound. However, there are some borderline cases where this need for 120 v could overbalance the cost advantages of the 480-v system. But don't place any building fluorescent lighting in the portable miscellaneous-load category. Fluorescent lighting is permanently installed and, during normal operation, out of reach of people in the building (NEC says it must be 8 ft from the floor). Only qualified electricians maintain such lighting.

Short-Circuit Protection. It's unlikely that arcing faults developed at 208 will be sustained since they are generally self-clearing. However, 480-v switching equipment must be designed to confine the arc within arcing chambers since the self-clearing assurance is not present. Also, short-circuit current is not reduced as rapidly at 480 as at 208 because of circuit impedance. This boils down to using higher-rated protective equipment on a 480-v system. On the other hand, reduced effect of circuit impedance at the higher voltage is an advantage, if adequate protective equipment is used, since on short circuit this equipment operates faster to isolate the fault.

You can get adequate short-circuit protection throughout a building if short-circuit duty at the main switchboard does not exceed 100,000 amp at 480 v. Circuit breakers, rated 100,000-amp interrupting capacity, may be used as service-entrance switches. High interrupting-capacity fuses (POWER, October 1953, pp 107-108) are suitable for 480-v circuits. But, if used, they need a load-interrupter switch having a momentary rating equal to the fuse let-through current.

Since short-circuit currents at 480 are not reduced as rapidly with lengths of cable or bus as they are at 208, it is quite likely that close to 100,000-amp short-circuit current is often available at panel boards, protecting branch circuits. Tests show that 277-v panel boards containing 20-amp breakers can be protected with current-limiting high interrupting-capacity fuses rated to 150 amp, even where the available short-circuit current is up to 100,000 amp. Where such a fuse-breaker combination is used, a fault close to the panel board on a branch circuit may blow the 150-amp fuse and open the branch circuit breaker. Where fusible panel boards are planned, figure on high-interrupting-capacity fuses in the branch circuits as well as in leads to panel.

Place reactors in incoming-line section of motor-control centers to reduce the 100,000-amp available short-circuit current to 25,000 or 15,000 amp for the motor starters. If individual starters are selected, the 100,000 amp available must be trimmed to 50,000 for the



480-V SINGLE-TENANT layout with major equipment in place. Plug-in duct is used to ease expanding as area load grows

480-V THREE-TENANT scheme uses same basic components as for single tenant but triple the number and a third the capacity

Cost comparison studies between 208Y/120 and 480Y/277 v, based on

fusible-type starters. This may be done with reactors or by taking advantage of cable impedance. Bus risers come with 100,000-amp short-circuit capacity.

Cost Picture. Installation costs vary widely in different areas. So in the following comparisons, installation costs are figured as 25% of the material costs. As actual installation costs increase, the pendulum swings farther in favor of the 480-v system since there is generally less equipment installed compared with a 208-v setup.

Main switching equipment can be either circuit breakers or fused switches. Number of circuits affect the relative cost of switching equipment. If it is assumed the same number of circuits are used at 480 as at 208, there is little difference in the over-all cost differential. But if we figure in the halved current at the higher voltage, using the same number of feeders or fewer feeders carrying more kva per line, there should be a material saving in main switchboard at 480 compared to 208 of equivalent capacity.

Cable or bus show the greatest savings at the higher voltage. The 480-v system always shows up well here since the same kva can be carried with less voltage drop and less copper than at 208 v. Also, the longer the run and the heavier the load, the greater the savings will be with a 480-v system.

Panel-board costs per circuit favor the lower voltage, comparing 277 and 125 v. But this can be trimmed somewhat by working each branch circuit at its ampere rating, then using but half the branch circuits at the higher voltage. Where 277-v branch circuits are used for the general-area lighting, two panel boards per floor area are usually required; one for 277-v lighting and one for 120-v floor circuits.

Auxiliary transformers are a small factor where miscellaneous 120-v load is low, say ½ to 2 va per sq ft. However, as more 480-120/240-v transformer capacity is required, savings shrink for the over-all 480-v system compared with a 208-v.

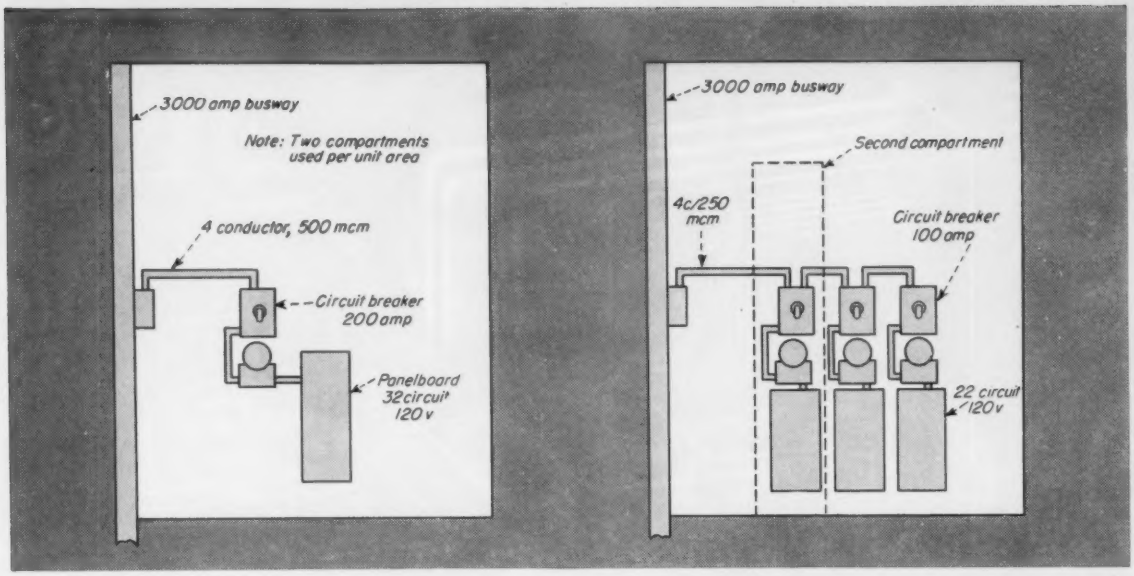
Branch circuits can chalk up a saving at 277 that generally offsets higher cost of the required two panel boards and the auxiliary transformers. There is no cost difference in fluorescent ballast provided a sizable quantity is needed, say 10,000 or more. In large buildings where 480 is most applicable, there should be no significant difference in fixture costs provided modern rapid-start or instant-start ballasts are used.

Motor costs hold about the same except for large air-conditioning motors rated above 500 hp. But there is a significant difference in the motor-control costs. A 15 hp, 480-v fusible combination motor starter lists at $162 while a 15-hp 208-v unit lists at $203. Where individual motor starters are used at 480 v, starter cost is lower than for a complete motor-control center. But more installation expense is involved with separate-mounted starters. Taking just the motor-starter cost alone, the differential between 480 and 208 is substantial. This differential increases when motor-control centers are used because buses and assembly are added to the motor-control centers.

What if 480 v is not available from the utility in the area? You can figure cost of stepping up the available 208 v through autotransformers at $8 per kva of building load. In any sizable building you generally find the transformer costs less than savings made with a 480-v system.

Building configuration plays its part in the cost picture. A relatively small ground area with a very tall building presents the greatest savings with 480 v because of the risers. A low building supplied near load-center areas shows a minimum saving in risers since they're of minimum length.

Losses in watts, even with stepdown transformers figured in, are in favor of 480 v. Enough copper could be put into a 208-v system to make losses the same, but this would further increase savings of the 480-v system. And the same holds true for voltage drop. But expect slight-



208-V SINGLE-TENANT plan is simple as no transformer is needed. Cable tapoff is shown but plug-in duct can be used

208-V THREE-TENANT setup with but one compartment shown. To lick voltage drop, two services generally used per unit area

assumed costs, show savings with higher voltage can reach $30 per kva

ly higher drop (1 to 2%) in the 120-v floor circuits because of the dry-type transformers.

Building Occupancy. Type of occupancy may have an important bearing on the practicality of adopting 277 for general lighting. For single large-area tenants limited to 4 or 6 per floor and general-area lighting fixtures supplied by building owner, 277-v lighting is practical, economical. But if there are many tenants per floor and each supplies lighting fixtures, the 120-v system is most practical since each tenant purchases but a small number of fixtures. Consequently, the quantity of 277-v ballasts required would probably not be readily and economically obtainable now.

If most of the building needs 120-v general-area lighting, consider transformers and a separate 208Y/120-v substation where primary power is bought.

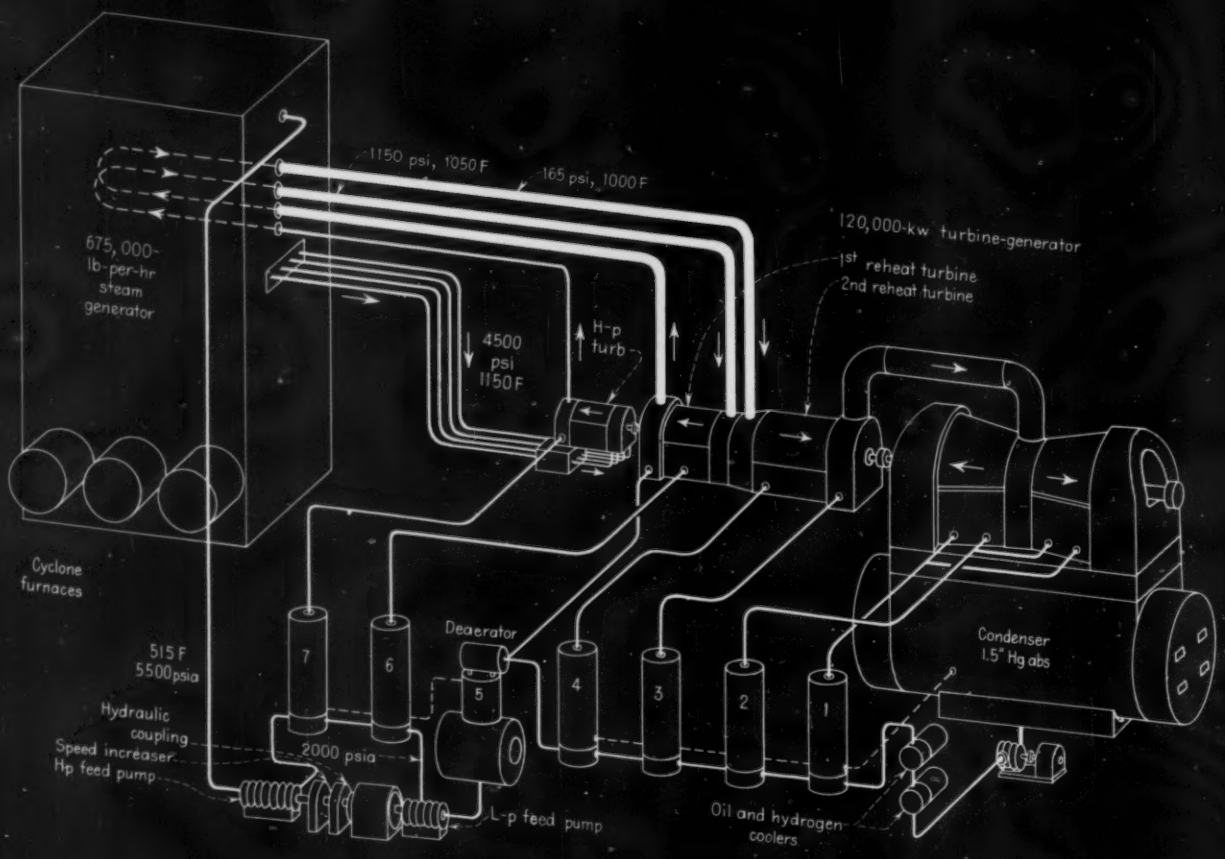
Finally, where a higher-voltage system is contemplated, regardless of whether it is called 480Y/277 or 460Y/265, heed the following six working fundamentals: (1) Make short-circuit current calculations based on 480 v, the no-load voltage rating. (2) Rate supply transformers at 480-v no load. (3) Remember, fluorescent-light ballasts are rated either 265 or 240-480. (4) Use 440 as the rating voltage for all motors and controls. (5) Capacitors are rated 460. (6) Heating devices for use on 480- or 460-v systems are rated 460.

Is Your Plant a Candidate for *Power's* MODERNIZATION AWARDS?

As announced last month (pp 100-101), POWER will cite those who have completed an outstanding modernization job in their powerhouse or plant proper. If you have renovated during 1952 or 1953, and feel quite proud of the job, here is your opportunity to have your skill and judgment recognized.

Results in those plants doing a top modernization job will be made known through POWER's pages. And plants selected for such accomplishment will receive a citation testifying to that fact —a citation that may be proudly displayed in your plant or office for all to see.

Renovation may involve the entire power-service system or any major part of it—in industry, institution or utility. Entries may be submitted by power-service staffs or consultants for their clients. To enter, simply write to POWER asking for a 1954 Modernization Award blank. Address your card or letter to Modernization Awards, POWER, McGraw-Hill Publishing Co, 330 West 42nd St, New York 36, New York.



1 **PROPOSED HEAT BALANCE** for 4500-psi unit at the Philo Station of the Ohio Power Co. Choosing feed pumps for a plant of this type involves a number of economic decisions that must be carefully analyzed before the plant is built

Selecting Superpressure Feed Pumps

Studies for high-speed high-pressure feed pumps are the basis for this analysis of essential factors in picking the feed cycle and its components

third in this series

by Igor J Karassik

Manager, Multistage Pump Section, Centrifugal Pump Division, Worthington Corp

► A 125,000-KW UNIT operating at 4500 psi is probably not large enough to be economically justifiable except for pilot use. Proper size for this pressure is possibly not less than 250,000 kw. Minimum economical capacity usually increases with operating pressure. At 6000 psi, for example, minimum size is about 400,000 kw.

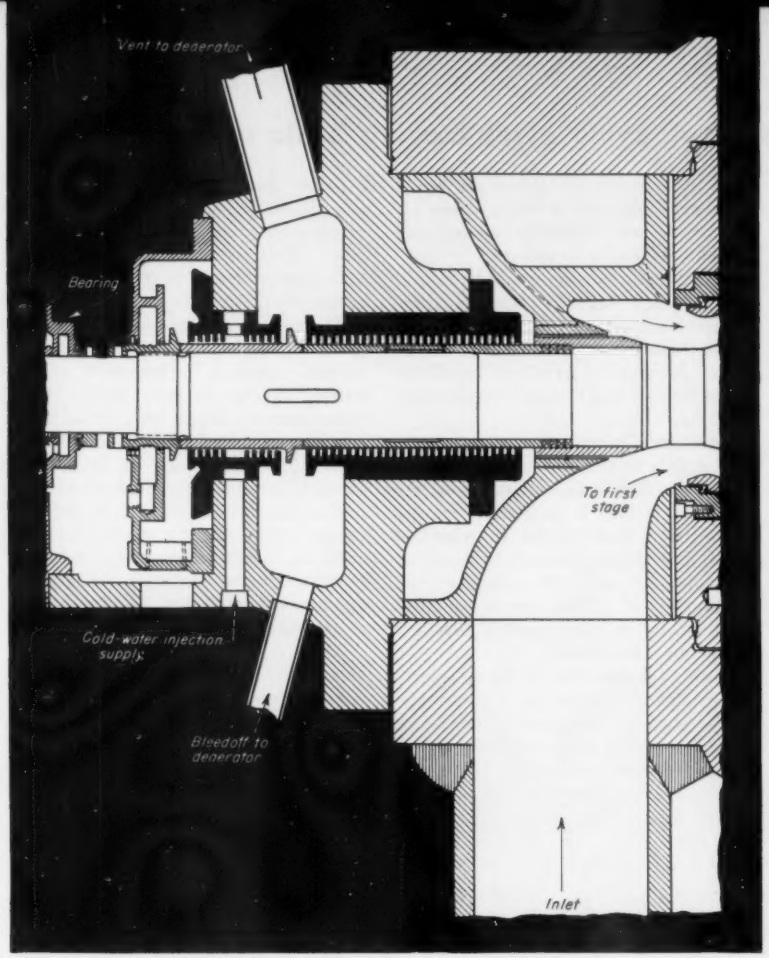
Studies. We'll analyze two 4500-psi installations here. First study is based on the 125,000-kw unit on order for Philo Station of the Ohio Power Co. Second covers feed pumps for a 250,000-kw unit with 1.4 million lb-per-hr throttle flow.

Philo will have two feed-pump sets, each designed to handle 60% of maximum throttle flow (675,000 lb per hr), or 405,000 lb per hr per set. No spare pump will be used—turbine load will be reduced if a pump is out of service. Since the steam generator does not have a drum, no capacity margin is required for boiler swings. The only capacity margin necessary is provision for pump wear.

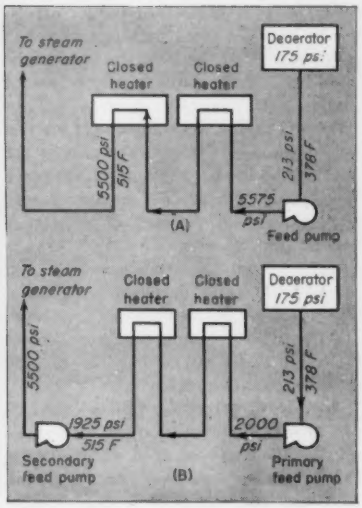
Pump Choice. With but one feed pump, or with constant-speed units, economics indicates a maximum pump capacity of not over 110% of throttle flow. However, choice of 60% throttle-flow capacity per pump (or 120% total) is logical because parallel variable-speed operation is contemplated. Eliminating a spare pump recognizes the fact that reduced load during pump repair is a reasonable premium for the smaller investment in pumps, drivers, piping, valves and controls.

Feed pumps take their suction from a 175-psia deaerator, Fig. 1. Final discharge pressure is 5500 psi. There is a friction loss of 1000 psi between pump

Packing superpressure pumps is a problem that requires study



2 **STUFFING BOX** for secondary pump has no packing. Breakdown sleeve replaces the conventional packing between the point of cold-water injection and exterior



3 **HOOKUP** for feed pump can use one pump, *A*, or two pumps in series, *B*

and turbine inlet at full-load operation.

The designer of a superpressure plant can choose either a single pump, Fig. 3A, or two pumps in series, Fig. 3B. With but one pump the high-pressure feedwater heaters are under full discharge pressure. With two pumps in series, the closed high-pressure heaters are located between the pumps. The low-pressure or primary pump handles 378-F water, discharging it at about 2000 psi. Temperature of feedwater leaving closed heaters is 515 F. The high-pressure or secondary pump discharges this water at about 5500 psi.

Single Pump. Both mechanical and economic advantages would result from using but one pump. Less floor space is needed, there are fewer stuffing boxes, the boxes are not subject to high pressures and temperatures, and power input is less because water is colder. Power saving is appreciable since power input to deliver a fixed weight of water against a given pressure is inversely proportional to the specific gravity. A pump handling 515-F water requires 13% more power than with 378-F water.

Two Pumps. Closed heaters suitable for 5500 psi place an almost prohibitive premium on the one-pump hookup. Also, reduction of total head to be developed by any one pump reduces shaft span needed, giving a more rigid unit. Lastly, this arrangement permits retention of existing boiler feed pumps if the superpressure unit is to top a high-pressure installation now in operation. The majority of the advantages favor the 2-pump arrangement for superpressures in modern central stations.

Heater Pressures. Once the 2-pump arrangement is chosen, you must pick the intermediate pressure for which the closed heaters are designed. This is based on a compromise between savings in heater costs and increase in pumping power with lower inlet pressures to secondary pump. A curve of resulting overall costs reaches an optimum value on a rather broad band of intermediate pressures. A discharge pressure of 1750 to 2250 psi for the primary pump gives comparable results. So in this analysis we will assume the primary pump discharges at 2000 psi.

Labyrinths. The secondary pump handles 515-F water with a suction pressure of 1925 psi at full load, 2400 psi at no load. This variation results from constant-speed operation of the primary pump, specific gravity increase of feedwater with load decrease, and reduction of friction between pumps with a reduction in load. Feed-pump experience shows that certain combinations of pressure, temperature and other factors can make it difficult to pack a pump satisfactorily. At the present time it appears that 2000 psi and 515 F at the secondary pump will definitely introduce a packing problem.

As a result, pressure-reducing labyrinths must be used ahead of the stuffing box. These will be bled back to some region of lower pressure in the feed cycle. For this analysis we'll assume the labyrinths are bled to the deaerating heater at the suction of the primary pump. This pump must then handle both the normal demand and any feedwater bled back to the heater. The amount of leakage will vary with complexity of the passages, length of the

Calculate performance of feed cycle after making basic assumptions

breakdowns, and clearance between rotating and stationary parts.

Here our primary interest is not in evaluating the excellence of a particular labyrinth design but in presenting a typical method for establishing service conditions for superpressure feed pumps. The calculations that follow assume a total leakage of 150 gpm per pump. This is a rather high leakage, but note that any reasonable value assumed has only a minor effect on analysis of pump performance. Correcting for specific gravity change from 515 to 378 F, means the primary pump must handle 132 gpm additional flow, instead of 150 gpm.

Assuming 75-gpm leakage at each end of the secondary pump, not only is the capacity of the primary pump increased 132 gpm, but also the secondary unit must handle 75 gpm over its net capacity because this quantity passes through the entire pump before leaking off. But in our analysis we'll consider leakoff at the balancing-device end of the secondary pump as affecting efficiency, rather than strictly as an increase of 75 gpm in gross pump capacity.

Service Conditions. Tables I and II list approximate service conditions on which this study of feed pumps for a 125,000-kw superpressure unit is based. Note that the effects of compressibility have not been taken into account. Compressibility should be considered in extremely accurate analyses, but it is not significant for our purposes.

A standard 6-in. 7-stage constant-speed 3570-rpm pump is suitable as a primary unit. Secondary pump would be a high-speed unit operating at variable speed. If one motor is to drive both pumps a 2-pole 3575-rpm unit with double extended shaft would be suitable. One shaft extension would be connected to a variable-speed device, such as a hydraulic coupling. This, in turn, would drive the secondary pump through a stepup gear.

With a gear efficiency of 97% and an over-all efficiency of 96% for the hydraulic coupling, motor input to secondary pump is 3130 hp. Total rating of the pump set is 4580 hp. A 4500-hp motor would be overloaded only 2%, which is quite acceptable for a 40-C-rise open motor. On the other hand, a 5000-hp motor would allow single-pump operation at flows greater than 405,000 lb per hr.

For a 250,000-kw unit, two solutions are possible. Assuming a total installed capacity of 120% of the maximum throttle flow of 1.4 million lb per hr, the first arrangement would use two pumps, each handling 840,000 lb per hr. However, total horsepower per pump set would be about 9500, and it might prove expensive to use 10,000-hp motors and 6000-hp hydraulic couplings.

An alternate solution would be to split the required capacity between three pump sets, each handling 40% of maximum throttle flow, or 560,000 lb per hr. Motor horsepower required would be about 6300, with a hydraulic coupling of 4350 hp.

Secondary Pump. As outlined in the first article in this series (Jan POWER, pp 73-78) high-speed operation of the secondary pump is desirable. Studies made before building the experimental pump described in that article show that a 4-stage unit, with 8-in. impellers running at about 12,000 rpm, is an ideal selection for the total head of 10,675 ft the pump must develop.

Stuffing Boxes. One of the most critical problems to be solved is the design of the stuffing boxes and labyrinths or breakdowns that must precede them. A complication related to labyrinths is the fact that leakoff from one end is at 515 F and that at the other about 533 F. This temperature rise results from a 4-F increase during passage through the pump and a 13.7-F rise from degradation of pressure energy in the balancing device. (This rise, incidentally, does not take into account the temperature increase resulting from compression.)

The vapor pressure of 533-F water is about 900 psi. Unless we are willing to maintain such a backpressure on the stuffing boxes, we must inject colder water into the breakdowns or allow a certain amount of flashing to occur in them. Flashing is not an impractical solution because tests show no damage to the pump if the design prevents excessive vibration and contact at running surfaces. Flashing some of the leakoff to steam helps reduce total leakage quantity because steam velocity through clearance space limits the flow.

There is good reason to believe that even if pressure at stuffing boxes is reduced to that in the deaerating heater, a difficult packing problem will still exist because peripheral velocities at shaft sleeves are in excess of those with which satisfactory field experience has been accumulated.

Some form of mechanical seal may be immediately suggested. But field experience with this type for boiler feed service is also lacking, even at 3600 rpm. Note that deflection at the stuffing boxes is only nominal because they are close to the pump bearings. But remember that the greatest angularity of the rotor occurs in the region of least deflection. It is this angularity that makes operation of mechanical seals hazardous. Absolute parallelism between rotating and stationary faces of a mechanical seal is a prime requisite for satisfactory output.

The most promising solution to the seal problem is a design field-tested on a number of 3600-rpm pumps. It combines cold-water injection from the condensate pump with a "nonpacked" stuffing box. A breakdown sleeve replaces conventional packing between the point of injection and the exterior, Fig. 2. Leakage is piped to a low-pressure point in the cycle, such as the condenser hotwell.

Since the discharge pressure of the condensate pump will always exceed the pressure in the deaerating heater, a small portion of the injection water will flow into the first breakdown leakoff chamber. Here it will mix with the leakoff from the pump interior and return to heater. Remainder returns to condenser. The accompanying power loss is negligible, being offset by power savings from the absence of packing friction.

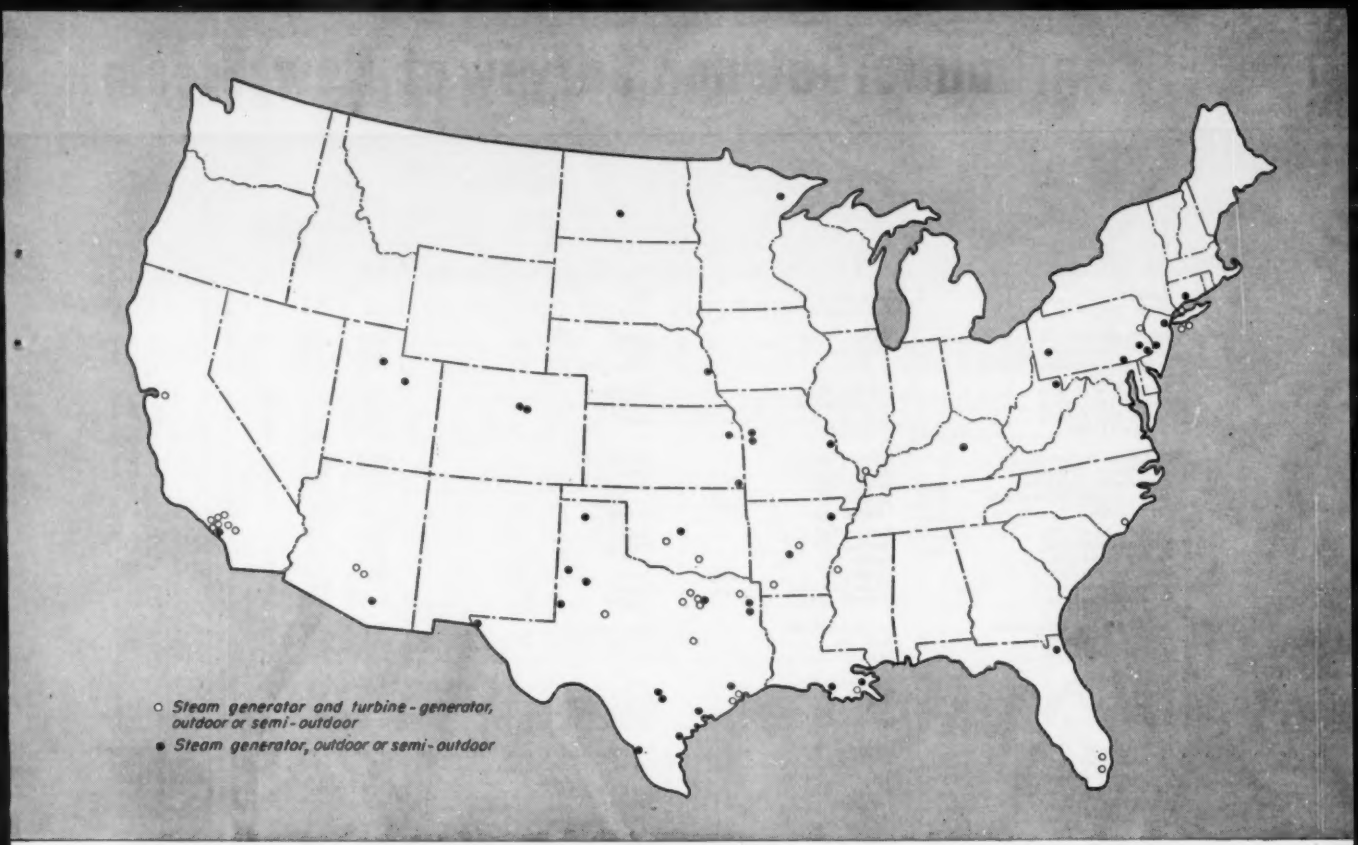
Next month we will discuss part-load operation of these pumps.

I: Performance of Primary Pump

Suction temp, F	378
Specific gravity	0.874
Vapor pressure, psig	175
Available npsh, ft	100
Req capacity, excl of leakoff at secondary pump, lb per hr	405,000
Leakoff capacity, lb per hr	58,000
Gross capacity, lb per hr	463,000
Gross capacity, gpm	1060
Suction pressure, psig	213
Discharge pressure, psig	2000
Net pressure, psi	1787
Total head, ft	4730
Assumed pump efficiency, %	76
Pump bhp	1450

II: Performance of Secondary Pump

Suction temperature, F	515
Specific gravity	0.773
Capacity, lb per hr	405,000
Capacity, gpm	1050
Assumed friction loss bet. primary and secondary pumps, psi	75
Suction pressure, psig	1925
Discharge pressure, psig	5500
Net pressure, psi	3575
Total head, ft	10,675
Assumed pump efficiency, %	75
Pump bhp	2920



NEW PLANTS with outdoor and semi-outdoor boilers and turbines appear in all parts of U.S., but are still in minority as shown by . . .

Survey of 267 New Central-Station Units

- **For some electrical equipment, plant designers adopt outdoor spots almost 100%**
- **For major items, such as boilers, turbines, condensers and feed pumps, indoor locations still predominate**
- **Induced-draft fans are major boiler auxiliary placed outdoors, others are more often placed under shelter**

► THE NEXT FOUR PAGES tabulate data for 174 central stations that have new units starting during the years 1953 to 1956, inclusive. This indoor-outdoor survey was summarized in the Jan 1954 issue of POWER, pp 92, 93, after being reported before the Dec 2, 1953 meeting of the ASME. Some of the general discussion at that meeting was reported in our Feb 1954 issue, pp 105 to 107.

The units tabulated represent almost 70% of the *number* of units and about 80% of the total mw capacity. They are distributed among 40 states in all sorts of climate and precipitation conditions.

Study of the individual data shows very little in the way of standardization, regarding indoor and outdoor arrangements of plants. Apparently individual conditions vary so much that uniformity offers few advantages.

Climate has not been a deterrent to some systems as shown by the map above. Plants with outdoor and semi-outdoor equipment appear in all parts of the country with the exception of the Pacific Northwest. However, outdoor plants seem to concentrate largely in the South and Southwest. A notable exception is the Southern System in the states of Alabama, Georgia, Mississippi and Florida. They do not use outdoor plants, as such, but they do place some of the plant auxiliaries outdoor at ground level. This system does its major overhauling during a heavy rainy season, which reduces attractiveness of an outdoor plant.

More on next page ▶

Indoor-Outdoor Survey of New Steam

Company	Location	Plant name	No. of units	Mw capacity and capability	Starting date	Annual precipitation, in.	Avg no. days per year below 32° F	Cooling tower	Cooling-water screens	Cooling-water pumps	Main condenser	Condenser vacuum pump
Alabama Power Co	Barry, Alabama	Barry	2	125[1]	12-53[2]	66	10	–	0	1	1	–
Alabama Power Co	Gorgas, Alabama	Gorgas	1	156[1]	10-55	63	69	–	0	1	1	–
Arizona Public Service Co	Red Rock, Arizona	Saguaro	2	90/99	6-54[3]	10	22	0	0	0	0	0
Salt River Power District	Tempe, Arizona	Kyrene	1	60/71[4]	6-54	7	6	0	0	0	1	0
Tucson Gas Electric Light & Power Co		De Moss Petrie	2	20/25[5]	6-53[5]	12	10	0	0	1	1	1
Arkansas Power & Light Co	Jones Mill, Ark	Lake Catherine	1	100/110	4-53	47	42	–	1	1	1	1
Arkansas Power & Light Co	No Little Rock, Ark	Cecil Lynch	1	125/135	2-54	47	42	0	–	0	0	0
Arkansas Power & Light Co	Stamps, Ark	Harvey Couch	1	125/135	1-54	47	35	0	–	0	0	0
City Water & Lt Plant	Jonesboro, Ark		1	7.5/9.4	6-53	50	–	0	0	1	1	1
California Electric Power Co	Highgrove, Calif.	Highgrove	1	40/44	11-53	22	10	0	–	0	0	0
City of Burbank, Pub Svce Dept	Burbank, Calif	Burbank	1	30/33	10-53	15	3	0	0	1	1	1
City of Glendale, Pub Svce Div	Glendale, Calif	Glendale	1	20[1]	10-53	18	3	0	0	1	1	–
City of Los Angeles, Dept of Wtr & Pwr	San Valley, Calif	Valley	4	100[1,6]	3-54[6]	15	0	0	0	1	1	1
City of Pasadena	Pasadena, Calif	Broadway	1	40/45	6-54	21	0.5	0	0	0	0	0
Pacific Gas & Electric Co	Pittsburg, Calif	Pittsburg	4	-/156	-54	13	56	–	0	0	0	1
Pacific Gas & Electric Co	Morro Bay, Calif	Morro Bay	2	-/156	-55	19	1	–	1	1	1	1
San Diego Gas & Electric Co	Carlsbad, Calif	Encina	1	80/100	10-54	11	0	–	0	0	1	1
Southern California Edison Co	Etiwanda, Calif	Etiwanda	2	100/125	7-53[7]	18	25	0	0	0	0	1
Southern California Edison Co	Redondo Beach, Calif	Redondo	1	125/156	10-54	12	0	–	0	0	1	1
Southern California Edison Co	El Segundo, Calif	El Segundo	1	125/156	7-55	12	0	–	0	0	0	1
City of Colo Springs, Dept of Pub Util	Colorado Springs, Colo	George Birdsall	2	16.5[1]	10-53[8]	14	150	0	0	1	1	1
Public Svce Co of Colorado	Denver, Colo	Arapahoe	1	100/-	8-55	14	162	0	0	1	1	1
Public Svce Co of Colorado	Denver, Colo	Zuni	1	66/-	6-54	14	162	0	0	1	1	1
Borough Electric Works	Wallingford, Conn	Pierce	1	22.5/28	2-54	45	30	0	0	1	1	1
Connecticut Light & Power Co	Uncasville, Conn	Montville	1	75[1]	4-54	35	100	–	1	1	1	1
The Hartford Electric Light Co	Middletown, Conn	Middletown	1	60/66	4-54	46	100	–	1	1	1	1
The United Illuminating Co	New Haven, Conn	English	1	30/40	9-53	45	110	–	1	1	1	1
City of Jacksonville, Elec Util Dept	Jacksonville, Fla	Southside	1	-/44	1-55	60	6	–	0	1	1	1
City of Tallahassee	St. Marks, Fla.	St. Marks	1	7.5[1]	7-54	58	14	–	0	0	1	1
Florida Power & Light Co	Cutler, Fla	Cutler	1	-/80	10-54	55	0	–	0	0	0	0
Florida Power & Light Co		South Florida	1	-/135	7-55	55	0	–	0	0	0	0
Gulf Power Co	Sneads, Fla	River Junction	2	40/49	-53[10]	60	15	–	0	1	1	1
Tampa Electric Co	Tampa, Fla.	Hookers Point	1	40/-	10-53	49	0	–	0	0	1	1
Georgia Power Co	Kranmert, Ga	Hammond	3	100/-	3-54[13]	52	75	–	1	1	1	–
Savannah Electric & Power Co	Savannah, Ga	Riverside	1	20/22	7-54	46	10	–	0	0	1	1
Central Illinois Pub Service Co	Hutsonville, Ill	Hutsonville	2	75[1]	-53[14]	36	100	–	1	1	1	1
Commonwealth Edison Co	Stickney, Ill	Ridgeland	2	150/-	12-53[15]	33	45	–	1	1	1	1
Commonwealth Edison Co	Romeo, Ill	Will County	2	150/-	-54[16]	33	45	–	1	1	1	1
Electric Energy Inc	Joppa, Ill	Joppa	6	125/156	4-53[17]	46	55	–	0	0	1	1
Iowa-Illinois Gas & Electric Co	Moline, Ill	Moline	2	20[1]	6-53[18]	33	122	–	0	1	1	1
Commonwealth Edison Co	Hammond, Ind	State Line	1	191/-	9-55	33	45	–	1	1	1	1
Indiana & Michigan Electric Co	Lawrenceburg, Ind	Tanner Creek	1	160/200	7-54	40	97	–	1	1	1	1
Indianapolis Light & Power Co	Martinsville, Ind	White River	1	68[1]	12-53	40	33	–	0	1	1	1
Municipal Electric Ltg & Power Plant	Richmond, Ind	Whitewater Valley	1	30[1]	10-54	45	110	0	0	1	1	1
No. Indiana Public Service Co	Gary, Ind		1	125/139	-56	37	110	–	1	1	1	1
Public Service Co of Indiana	Terre Haute	Wabash River	4	99[1]	7-53[22]	40	126	–	1	1	1	1
So Indiana Gas & Electric Co	Yankeetown, Ind	F Bayard Culley	1	40/50	1-55	41	78	–	0	1	1	1
City of Cedar Falls	Cedar Falls, Iowa	Steam Plant	1	5/-	9-54	–	–	–	–	1	1	1
Corn Belt Power Cooperative	Humboldt, Iowa	Humboldt	1	15/16.5	1-54	–	–	0	1	1	1	1
Iowa Electric Light & Power Co	Marshalltown, Iowa	Marshalltown	2	30/-	12-54[20]	40	100	1	–	1	1	1
Iowa Public Service Co	Carroll, Iowa	Carroll	1	5/5.2	6-53	30	–	0	0	1	1	1
Iowa Public Service Co	Storm Lake, Iowa	Hawkeye	1	-/11.7	10-53	30	–	0	0	1	1	1
Iowa Southern Utilities Co	Eddyville, Iowa	Bridgeport	1	20/22	9-53[21]	30	–	0	1	1	1	1
The Empire District Electric Co	Riverton, Kansas	Riverton	1	40/44	3-54	43	60	–	1	0	1	1
The Kansas Power & Light Co	Lawrence, Kansas	Lawrence	2	30/36	1-53[23]	30	–	0	0	1	1	1
East Ky Rural Elec Cooperative Corp	Ford, Ky	William C Dale	2	20[1]	-53[25]	44	91	–	0	0	1	1
Kentucky Utilities Co	Central City, Ky	Green River	1	60/75	3-54	41	78	–	0	1	1	1
Kentucky Utilities Co	Tyrone, Ky	Tyrone	1	60/75	7-53	44	91	–	0	1	1	1
Louisville Gas & Electric Co	Louisville, Ky	Cane Run	2	100[1]	7-54[24]	46	17	–	1	1	1	1
Central Louisiana Electric Co Inc	Baldwin, La	Teche	1	50[1]	6-56	60	–	–	0	0	1	1
Gulf States Utilities Co	Baton Rouge, La	Louisiana	2	55[1]	7-54[54]	59	17	–	–	–	–	–
Louisiana Power & Light Co	Westwego, La	Ninemile Point	1	-/108	7-53	–	–	–	0	0	0	0
New Orleans Public Service Co	New Orleans, La	A B Paterson	1	65/81	4-53	58	10	–	0	0	1	1
Bangor Hydro Electric Co	Veazie, Maine	Edward M Graham	1	-/12.6	6-54	42	–	–	1	1	1	1
Maine Public Service Co	Caribou, Maine	Caribou Steam	1	12.6[1]	4-54	35	194	–	1	1	1	1
Cons Gas Elec Lt & Pwr Co of Baltimore	Baltimore, Md	Herbert A Wagner	1	125/-	10-55	43	73	–	0	0	1	1
Cons Gas Elec Lt & Pwr Co of Baltimore	Baltimore, Md	Riverside	1	75/-	9-53	43	73	–	0	0	1	1
Boston Edison Co	Weymouth, Mass	Edgar	1	81[1]	6-54	42	–	0	1	1	1	1
Board of Water & Elec Lt Commissioners	Lansing, Mich	Moores Park	1	40/44	5-54	31	149	–	1	1	1	1
Consumers Power Co	Erie, Mich	Justin R Whiting	1	106[1]	12-53	50	150	–	1	1	1	1
Pub Ltg Commission, City of Detroit	Detroit, Mich	Mistersky	1	40/50	1-55	32	126	–	1	1	1	1
The Detroit Edison Co	St Clair, Mich	St Clair	4	125/156	9-53[26]	32	100	–	1	1	1	–
The Detroit Edison Co	River Rouge, Mich	River Rouge	2	260/273	4-56[27]	32	100	–	0	1	1	–
City Electric Dept	Rochester, Minn		1	11.5[1]	-53	–	–	–	1	1	1	1
Minnesota Power & Light Co	Aurora, Minn	Aurora	2	44/46	5-53[28]	27	171	–	0	0	1	1
Municipal Utilities	Austin, Minn	Municipal	1	10/12.5	2-54	33	116	0	1	1	1	1
Water & Light Dept	Virginia, Minn		1	7.5/-	6-54	33	150	–	0	1	1	1
Mississippi Power & Light Co	Cleveland, Miss	Delta	2	100[1]	12-53	–	–	0	0	0	0	0
Mississippi Power Co	Meridian, Miss	Plant Sweatt	1	40[1]	7-53	–	–	0	0	1	1	1
Central Electric Power Cooperative	Chamois, Mo	Chamois	1	15[1]	11-54	–	–	–	0	0	1	1
Kansas City Power & Light Co	Kansas City, Mo	Hawthorn	2	100[1]	6-53[29]	36	29	–	0	1	1	1
Missouri Pub Service Co	Pleasant Hill, Mo	Ralph Green	1	22/27	3-54	30	96	0	0	0	1	1
Union Electric Co of Missouri	St Louis Co, Mo	Meramec	2	125/140	4-53[30]	39	39	–	S	S	1	1
Omaha Public Power District	Omaha, Neb	North Omaha	1	60/75	3-54	26	120	–	1	1	1	1

0—Outdoor
1—Indoor
S—Semi-outdoor
A—Part outdoor, part indoor
B—Part outdoor, part semi-outdoor
C—Part indoor, part semi-outdoor
Where unit sizes are not stated in footnote, assume size as listed in table.

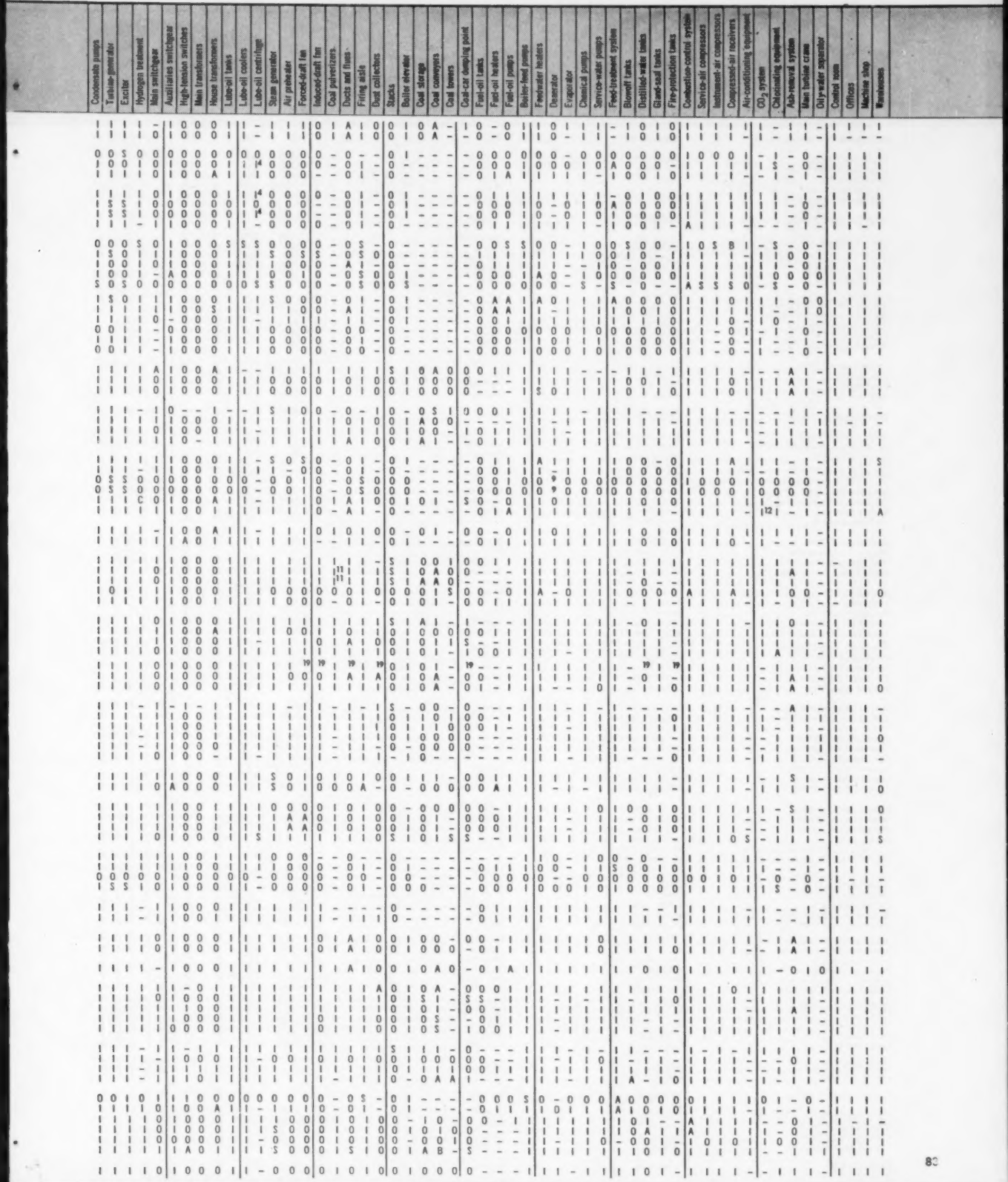
1—Not specified as capacity or capability
2—Second unit starts 4/54
3—Second unit starts 4/55
4—Lubricating oil filter
5—Second unit of 40/50 starts 6/54
6—Second unit of 100[1] starts 6/54
Third unit of 156[1] starts 12/54
Fourth unit of 156[1] starts 12/55

7—Second unit starts 11/53
8—Second unit starts 2/54
9—Deaeration in condenser
10—Second unit starts 11/53
11—Coal Crushers
12—CO_2 purging system for generator
13—Second unit starts 6/54
Third unit starts 6/56

14—Second unit starts -54
15—Second unit starts spring 54
16—Second unit starts summer 54
17—Second unit starts 7/53
Third unit starts 2/54
Fourth unit starts 6/54
Fifth unit starts 5/55
Sixth unit starts 7/55

18—Second unit starts 12/54
19—Not yet determined
20—Second unit starts 8/55
21—Second unit starts 11/53
22—Second unit starts 12/53
Third unit starts 8/54
Fourth unit starts 10/54
23—Second unit starts 12/54

Central-Station Installations, 1953-1956

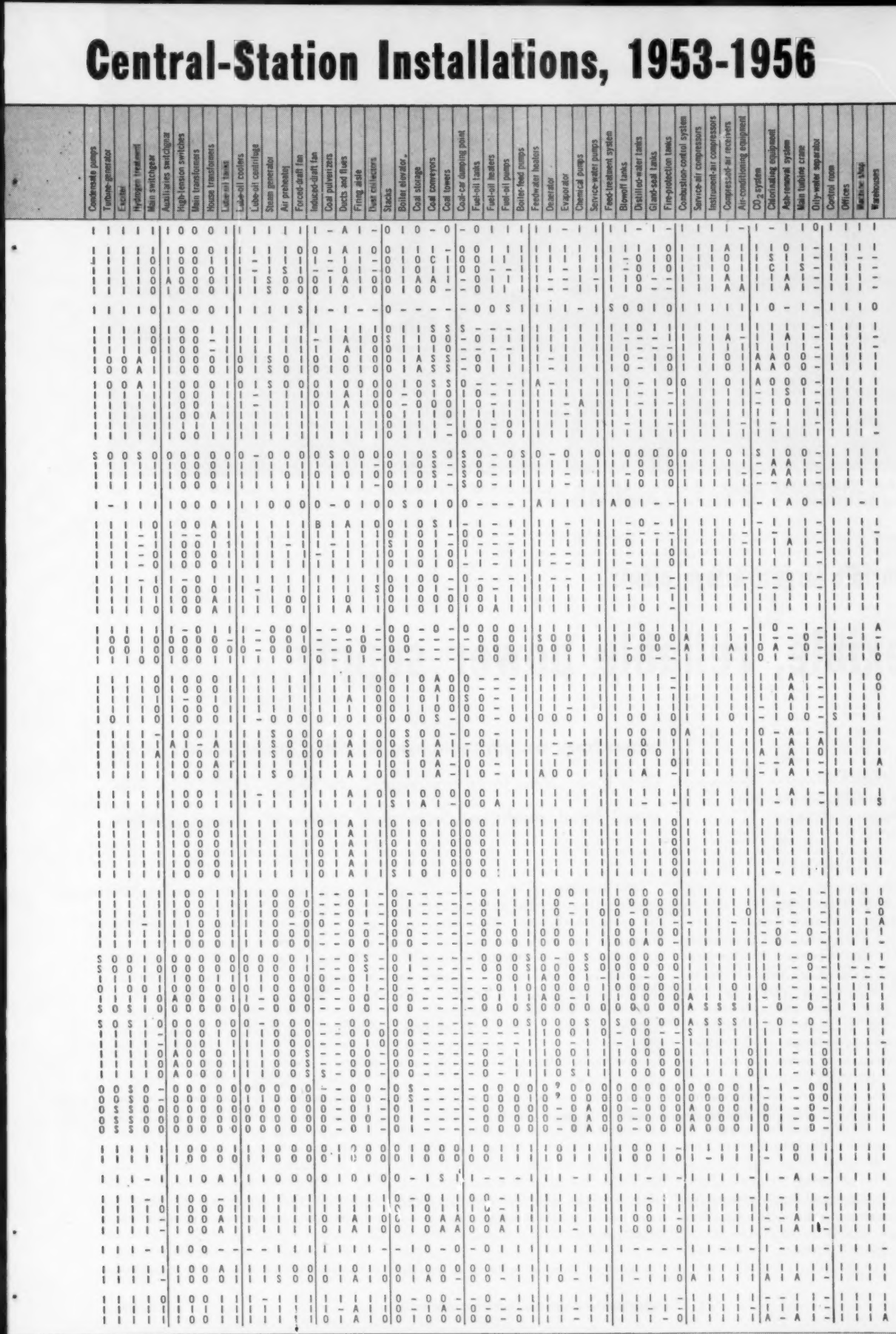


24.–Second unit starts 9/55
25.–Second unit starts -56
26.–Second unit starts 12/53
Third unit starts 6/54
Fourth unit starts 12/54
27.–Second unit starts 11/56
28.–Second unit starts 8/53
29.–Second unit starts 6/55
30.–Second unit starts spring 54
31.–Second unit starts 10/53
32.–Second unit starts 7/54
33.–Second unit starts -54
34.–Second unit starts 3/55
35.–Second unit starts 12/53
36.–Second unit starts 10/54
37.–Second unit of 125[1] starts 10/54
38.–Second unit starts 6/53
39.–Second unit starts 12/53
40.–Second unit starts 10/54
41.–Second unit starts 12/53
Third unit starts 7/54
Fourth unit of 208[1] starts 12/55
42.–Second unit starts 3/54
43.–Second unit of 125[1] starts 5/54
44.–Second unit starts 2/56
45.–Second unit starts 8/53
46.–Second unit of 200[1] starts 2/55
47.–Second unit of 85[1] starts 2/54
Third unit of 110 starts summer 55
48.–Second unit starts 12/53
49.–Second, third, and fourth unit starts -55
50.–Second unit scheduled for future date
51.–Second and third unit starts -56
52.–Three more units of 135/150 and four more units of 180/200 start -65
53.–Eight units installed to -55
54.–Second unit starts 9/54
55.–Second unit of 105/115 starts 1/55
56.–Second unit of -/165 starts 3/56
57.–Second unit starts 5/55

Indoor-Outdoor Survey of New Steam

Company	Location	Plant name	No. of units	Net capacity and capability	Starting date	Annual precipitation, in.	Avg no. days per year below 32° F	Cooling tower	Cooling-water screens	Cooling-water pumps	Main condenser	Condenser vacuum pump
Public Service Co of New Hampshire	Portsmouth, N H	Schiller	1	50[1]	7-55	38	100	–	0	1	1	1
Atlantic City Electric Co	Deepwater, N J	Deepwater	1	60/75	10-54	42	5	–	0	0	1	1
Jersey Central Power & Light Co	South Amboy, N J	E H Werner	1	62.5[1]	4-53	26	90	–	1	1	1	1
Jersey Central Power & Light Co	Sayreville, N J	Raritan River	1	125[1]	2-55	26	90	–	1	1	1	1
Public Service Electric & Gas Co	Kearny, N J	Kearny	2	145/153	3-53[31]	47	80	–	0	0	1	1
Public Service Electric & Gas Co	Burlington, N J	Burlington	1	185[1]	12-54	46	80	–	0	0	1	1
Plains Elec Gen & Transmission Coop Inc	Algodones, N M	Algodones	2	30/35	6-54[32]	8	126	0	–	1	1	1
Central Hudson Gas & Electric Corp	Roseton, N Y	Danskammer Point	1	60/66	8-54	45	50	–	1	1	1	1
Consolidated Edison Co of N Y Inc	New York, N Y	Astoria	1	180[1]	11-53	43	91	–	1	1	1	1
Consolidated Edison Co of N Y Inc	New York, N Y	East River	1	180[1]	5-55	43	91	–	1	1	1	1
Long Island Lighting Co	Far Rockaway, N Y	Far Rockaway	1	90/113	-53	47	–	–	1	1	1	1
Long Island Lighting Co	Glenwood Landing, N Y	Glenwood	1	90/113	-54	47	–	–	1	1	1	1
Long Island Lighting Co	Island Park, N Y	Edward F Barrett	1	125/175	-56	47	–	–	0	0	1	1
New York State Electric & Gas Corp	Dresden, N Y	Greenidge	1	75/100	1-54	30	130	–	–	1	1	1
New York State Electric & Gas Corp	Ludlowville, N Y	Milliken	1	108/135	8-55	35	130	–	–	1	1	1
Niagara Mohawk Power Corp	Albany, N Y	Albany	2	80/100	-53[33]	37	129	–	1	1	1	–
Rochester Gas & Elec Corp	Rochester, N Y	Russell	1	50/70	10-53	33	100	–	1	1	1	–
Rockland Light & Power Co	Tomkins Cove, N Y	Lovett	1	66/70	12-54	45	100	–	1	1	1	1
Carolina Power & Light Co	Wilmington, N C	Wilmington	2	100[1]	6-54[34]	49	26	–	0	0	0	0
Duke Power Co	Spencer, N C	Buck	2	125/135	9-53[35]	48	64	–	1	1	1	1
Duke Power Co	Draper, N C	Dan River	1	150[1]	7-55	44	64	0	1	1	1	1
Duke Power Co	Mt Holly, N C	Riverbend	2	133/140	8-54[36]	46	64	–	1	1	1	1
Montana-Dakota Utilities Co	Mandan, N D	Mandan	1	25/29.4	9-54	16	198	–	1	1	1	1
Cincinnati Gas & Electric	New Richmond, Ohio	Walter C Beckjord	2	100[1,37]	10-53[37]	38	89	–	1	1	1	1
City of Cleveland-Division of Lt & Pwr	Cleveland, Ohio	Lake Road	2	25[1]	3-53[38]	–	–	–	1	1	1	1
City of Hamilton, Ohio	Hamilton, Ohio	Municipal	1	10[1]	1-54	40	169	–	1	1	1	1
Ohio Edison Co	Niles, Ohio	Niles	2	-/106	2-53[39]	–	–	–	1	1	1	1
Ohio Edison Co	Shadyside, Ohio	R E Burger	2	-/135	7-54[40]	–	–	–	1	1	1	1
Shelby Municipal Light Plant	Shelby, Ohio	Municipal	1	7.5[1]	5-54	–	65	0	0	1	1	1
The Cleveland Elec Illuminating Co	Eastlake, Ohio	Eastlake	4	140[1,41]	10-53[41]	32	114	–	1	1	1	1
The Ohio Power Co	Relief, Ohio	Muskingum River	2	160/200	12-53[42]	39	97	–	1	1	1	1
The Toledo Edison Co	Toledo, Ohio	Maumee Bay	1	142[1]	-55	32	98	–	1	–	1	1
Oklahoma Gas & Electric Co	Okla City, Okla	Mustang	1	100/110	3-55	30	30	0	–	0	1	1
Oklahoma Gas & Electric Co	Sulphur, Okla	Arbuckle	1	66/81.5	-53	30	30	0	–	0	S	1
Public Service Co of Oklahoma	Washita, Okla	Southwestern	1	80[1]	2-54	27	59	0	0	0	0	1
Western Farmers Electric Coop	Anadarko, Okla	Anadarko	1	15/18	7-53	24	60	0	0	1	1	1
Duquesne Light Co	Elrama, Pa	Elrama	2	100[1,43]	4-53[43]	36	102	–	1	1	1	1
Duquesne Light Co	Wireton, Pa	Phillips	1	156[1]	3-55	36	102	–	1	1	1	1
Metropolitan Edison Co	Reading, Pa	Titus	1	75/80	4-53	41	98	–	0	1	1	1
Pennsylvania Electric Co	Shawville, Pa	Shawville	2	-/137.5	4-54	–	125	0	0	1	1	1
Pennsylvania Power & Light Co	Martins Creek, Pa	Martins Creek	2	132.5[1]	5-54[44]	43	127	–	0	0	1	1
Pennsylvania Water & Power Co	Holtwood, Pa	Holtwood	1	60/66	4-54	36	98	–	1	1	1	1
Philadelphia Electric Co	Philadelphia, Pa	Delaware	2	125[1]	4-53[45]	43	18	–	0	0	1	1
Philadelphia Electric Co	Cromby, Pa.	Cromby	2	150[1,46]	4-54[46]	43	18	–	0	1	1	1
The Scranton Electric Co	Exeter Twnship, Pa	Stanton	1	40/-	10-53	37	120	–	1	1	1	–
West Penn Power Co	Springdale, Pa	Springdale	1	125/135	5-54	36	102	–	0	0	1	1
South Carolina Electric & Gas Co	Beach Island, S C	Urquhart	3	85[1]	12-53[47]	–	–	–	0	1	1	1
South Carolina Public Service Auth	Pinopolis Junct, S C	Santee-Cooper	2	40/51	10-53[48]	46	9	–	1	1	1	1
Tennessee Valley Authority	Pickwick Lake, Ala	Colbert	4	180/200	10-54[49]	52	40	–	0	0	1	1
Tennessee Valley Authority	Gallatin, Tenn	Gallatin	2	225/250	11-55[50]	51	60	–	0	0	1	1
Tennessee Valley Authority	Rogersville, Tenn	John Sevier	3	180/200	6-55[51]	45	63	–	0	0	1	1
Tennessee Valley Authority	Kingston, Tenn	Kingston	9	135/150[52]	2-54[52]	52	63	–	0	0	1	1
Tennessee Valley Authority	Paducah, Ky	Shawnee	10	135/150	4-53[53]	46	64	–	0	0	1	1
Tennessee Valley Authority	Bridgeport, Ala	Widows Creek	2	113/125	-54	52	50	–	0	0	1	1
Central Power & Light Co	Laredo, Texas	Laredo	1	33[1]	2-54	19	2	0	0	1	1	1
Central Power & Light Co	Calallen, Texas	Lon C Hill	1	66[1]	4-54	30	2	0	0	1	1	1
Central Power & Light Co	Victoria, Texas	Victoria	1	66[1]	1-55	36	4	–	0	0	1	1
City of Lubbock	Lubbock, Texas	Plant 2	1	-/12.5	7-53	26	10	0	–	1	1	1
City Public Svce Bd, San Antonio, Texas	San Antonio, Texas	Leon Creek	1	60/66	6-53	25	10	0	0	0	1	1
City Public Svce Bd, San Antonio, Texas	San Antonio, Texas	North Side	1	60[1]	6-54	25	15	0	0	0	1	1
Dallas Power & Light Co	Dallas, Texas	Parkdale	2	82/87[55]	5-53[55]	34	30	0	1	0	0	0
Dallas Power & Light Co	Dallas, Texas	Mt Creek	1	105/115	1-56	34	30	–	0	0	0	0
Dallas Power & Light Co	Dallas, Texas	Dallas	1	71/75	3-54	34	30	0	0	0	1	1
El Paso Electric Co	El Paso, Texas	Rio Grande	1	38[1]	9-54	9	90	0	0	0	0	0
Houston Lighting & Power Co	Houston, Texas	Deepwater	1	125/156	2-55	46	8	–	0	0	1	1
Houston Lighting & Power Co	Webster, Texas	Webster	2	80/100	6-54	46	8	0	0	0	0	0
Houston Lighting & Power Co	LaPorte, Texas	Sam Bertron	1	125/156	2-56	46	8	0	0	0	0	0
Southwestern Gas & Electric Co	Lone Star, Texas	Lone Star	1	40/44	2-54	45	20	–	0	0	1	1
Southwestern Gas & Electric Co	Lake Cherokee, Texas	Knox Lee	1	60/75	4-56	45	20	–	0	0	1	1
Southwestern Public Service Co	Denver City, Texas	Denver City	1	50/-	7-54	16	92	0	0	1	1	1
Southwestern Public Service Co	Dumas, Texas	Moore County	1	50/-	7-54	20	92	0	0	1	1	1
Southwestern Public Service Co	Earth, Texas	Plant "X"	1	100/-	5-55	18	90	0	0	1	1	1
Texas Electric Service Co	Ft Worth, Texas	Eagle Mountain	2	-/115[56]	3-54[56]	33	32	–	0	0	0	0
Texas Electric Service Co	Colorado City, Texas	Morgan Creek	1	-/70	5-54	21	65	–	0	0	0	0
Texas Power & Light Co	Bogata, Texas	River Crest	1	80/100	5-54	40	38	0	0	0	0	0
Texas Power & Light Co	Frisco, Texas	Collin	1	145/145	3-55	40	30	0	0	0	0	0
Texas Power & Light Co	Waco, Texas	Lake Creek	1	65.6/82	4-53	35	28	0	0	0	0	0
Utah Power & Light Co	Salt Lake City, Utah	Gadsby	1	100[1]	5-55	16	105	0	0	0	1	1
Utah Power & Light Co	Castle Gate, Utah	Carbon	1	60/66	1+54	10	–	0	0	1	1	1
Burlington Electric Light Dept	Burlington, Vt	Burlington	3	10/-	4-54	32	148	–	1	1	1	1
City of Danville, Wtr, Gas & Elec Depts	Danville, Va	Brantly	1	11.5[1]	6-53	50	60	–	0	1	1	1
Potomac Electric Power Co	Alexandria, Va	Potomac River	2	90/100	5-54[57]	41	86	–	1	1	1	1
Virginia Electric & Power Co	Dumfries, Va	Possum Point	1	100/110	5-55	42	71	–	0	0	1	1
Virginia Electric & Power Co	Portsmouth, Va	Portsmouth	1	100/110	9-54	45	40	–	0	0	1	1
Tacoma City Light	Tacoma, Wash	Plant No. 2	1	20[1]	4-54	39	3	–	0	1	1	–
Appalachian Electric Power Co	Glasgow, W Va	Kanawha River	2	160/200	-53	45	99	–	1	1	1	1
Monongahela Power Co	Albright, W Va	Albright	1	135[1]	9-54	54	–	0	0	1	1	1
Dairyland Power Cooperative	Cassville, Wis	Stoneman	1	30[1]	12-53	31	158	–	1	1	1	1
Manitowoc Public Utilities	Manitowoc, Wis	Manitowoc	1	20[1]	-56	–	–	–	1	1	1	1
Wisconsin Electric Power Co	Oak Creek, Wis	Oak Creek	1	120[1]	9-53	29	125	–	1	1	1	1

Central-Station Installations, 1953-1956



TWO 36-FT ICEBREAKERS protect barges from ice flows when unloading coal or alloy raw materials in the winter. The dock unloading equipment, belt conveyors and railroad tracks are above the highest recorded flood level here on the Ohio River

At world's largest alloys plant:

Flexible, reliable power supply...

comes from modern central-station setup on north bank of the Ohio River, close to its coal supply. Building, designed to withstand flood conditions, uses wall panels of precast concrete

By **E H MANGAN**, *Executive Vice-President* and **J M BANDEL**, *Vice-President*
Electro Metallurgical Company

► LARGE AMOUNTS of power are required for operation of huge submerged-arc furnaces and for electrolytic production of chromium and manganese metals at the Electro Metallurgical Company's new plant near Marietta, Ohio. In addition, the plant has large process-steam, water and compressed-air demands. These services, distributed in underground systems, are furnished from a central-type power station.

Thus in designing the power facilities at Marietta, prime consideration was given to reliability and continuity of service in a flexible system designed to satisfy a variety of load conditions. The plant was designed for as high an overall efficiency as could be justified by relatively low-cost fuel from nearby strip mines. Location on the bank of a river where occasional severe floods occur dictated special features of building design.

Coal Handling. One of the primary considerations in locating the plant was the nearby coal fields. Ohio strip- and deep-mine coal is shipped in from these fields by truck, barge and rail. Coal received by truck is either placed in storage or put through a hopper house. Coal taken into the hopper house is passed through a single-roll crusher, which reduces it to 6 in. and smaller. A conveyor belt then takes it to the main crusher house.

Coal received by barge and rail is brought into the main crusher house by conveyor belt. There all coal is reduced to ¾ in. and under. From the crusher house, it can be either belt-conveyed to the boiler house or stocked out by a boom conveyor. Bulldozers and scrapers handle coal in the storage pile. It is reclaimed from storage through the hopper house.

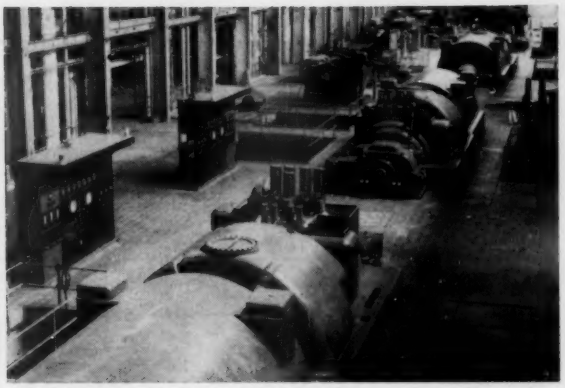
Transfer conveyor belts and shuttle conveyors in the boiler house take the ¾-in. coal to the bunkers. From there, it goes by means of coal pipes to the coal scales, and thence to the pulverizers.

Boilers. Four identical, radiant dry-bottom boilers, each with 650,000-lb-per-hr steam capacity, were chosen to take care of the steam-generating needs. For flexibility, boilers 1 and 2 are cross-connected with turbines 1 and 2, as are boilers 3 and 4 with their turbines.

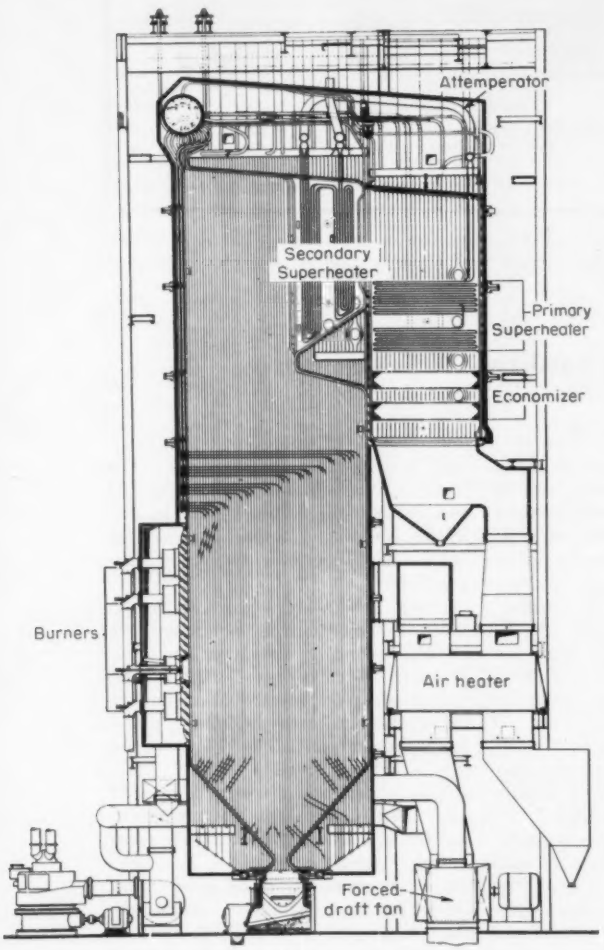
These pulverized-coal-fired units have a superheater outlet pressure and temperature of 1325 psig and 950 F. A spray-type attemperator controls steam temperature. Mechanical dust collectors and electrostatic precipitators in series keep stack emission to a minimum. Superheaters and economizers are cleaned by automatic air-puff soot blowers. Air heaters are regenerative type.

A pneumatic system removes flyash from boiler hoppers. The flyash is

ELECTRICAL CONTROL ROOM is air conditioned, has a loudspeaker system, and large window overlooking the turbine room



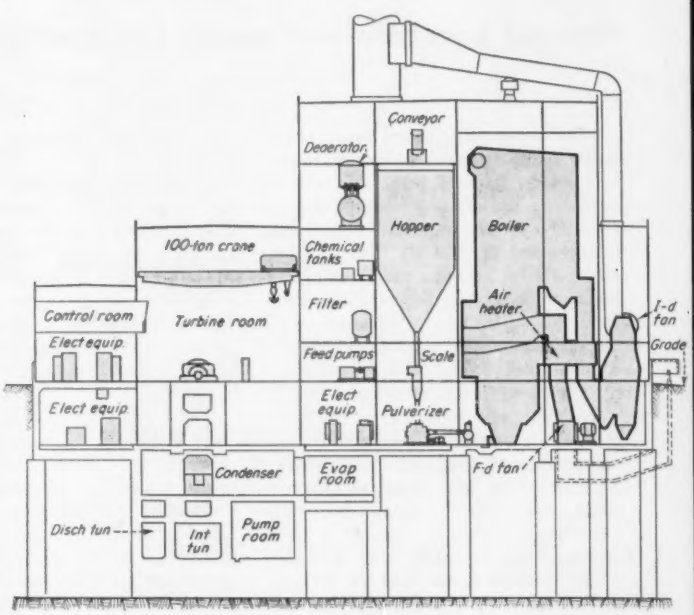
TURBINES have single automatic extraction point and four variable-pressure bleed points, one used at times for re-entry



Duplication is key to flexibility

FOUR RADIANT BOILERS have four pulverizers a boiler, regenerative air preheaters, mechanical dust collectors and electrostatic precipitators in series, and dry-bottom furnaces

DEEP-PIT DESIGN protects plant from flood stages of Ohio River. The operating floor is six feet above highest flood level recorded. Low intake insures water supply at low level

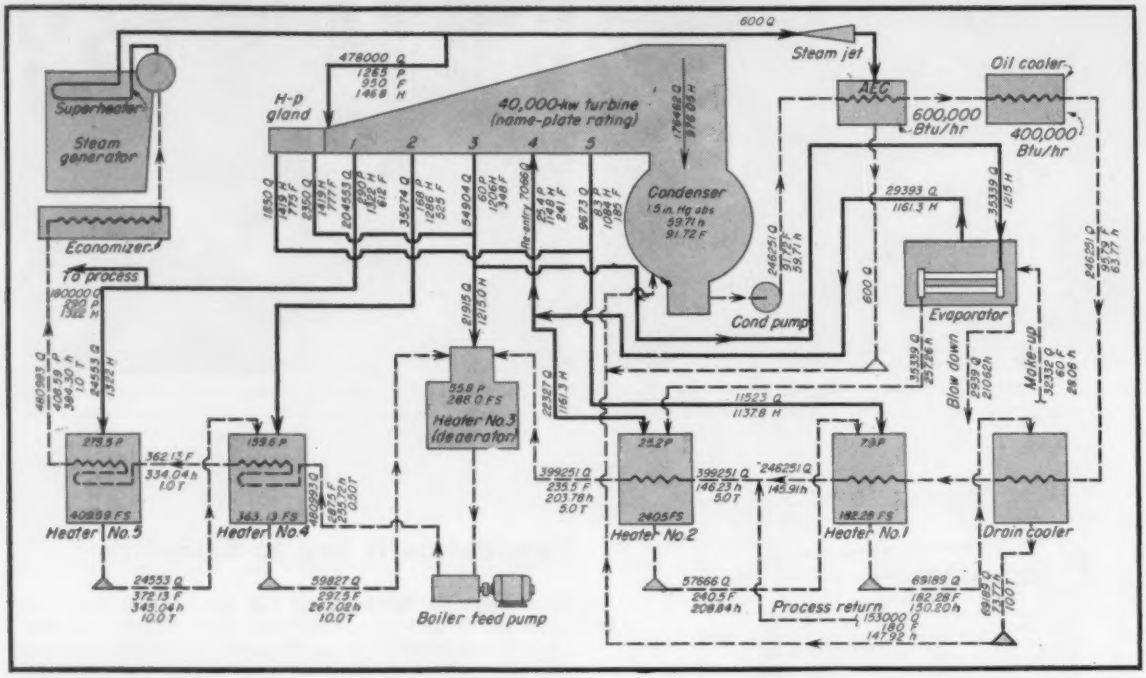


sluiced to a settling pond to the west of the plant. Bottom ash is sluiced out of the furnace hoppers and is pumped to the settling pond.

Turbine-Generators. Four tandem-compound turbines have a rated capacity of 40,000 kw and a capability of 50,000 kw each. The total output could take care of the domestic needs of Philadelphia. Generators are cooled by hydrogen, working up to a maximum pressure of 30 psig.

Process steam, as well as steam for feed heating, is normally taken from a single automatic extraction point. Turbines have four additional variable-pressure bleed points. At certain loads, one of these is a re-entry point.

Turn page



HEAT BALANCE at about rated capacity, 180,000-lb-per-hr process steam with 85% returns. Five-stage feed heating, ½% makeup feed. Evaporator vapor is condensed in No. 2 heater, cascaded through No. 1 heater and drain cooler to hotwell

Precast concrete wall-panel construction realizes 35% savings

Process steam, as stated above, is normally taken from an automatic extraction point. Each turbine is capable of supplying 180,000 lb per hr at pressures from 260 to 330 psig, and a maximum temperature of 700 F. Should plant requirements become excessive or unbalanced, steam can be supplied direct from boilers by way of pressure-reducing desuperheating stations after boiler superheaters. Each boiler can thus supply 300,000 lb per hr at 275 psig, 467 F.

This alternate system gives flexibility to meet all possible conditions. Should an unbalanced condition exist between electrical load and process-steam demand, steam can be obtained directly from the superheater through a pressure-reducing desuperheating station.

The process-steam line is welded-steel pipe using corrugated expansion joints with equalizing rings, limit rods and stainless-steel inner sleeves. A concrete trench houses this main and the return line between power station and alloys plant. As parts of this line could be subject to flood conditions, it was so insulated that it could be operated under these conditions.

Makeup and Service Water. Water for power and industrial uses is taken from the Ohio River. Traveling screens in the power-plant intake tunnel remove the large debris. Industrial water is then pumped from the intake tunnel to the plant by eleven 10,000-gpm pumps. Makeup water is pumped to clariflocculating tanks to remove small debris, and then goes to a storage tank. A pump sends it through zeolite softeners to an evaporative preheater and the evaporator.

The evaporator vapor is condensed in No. 2 heater. Condensate cascades through No. 1 heater and drain cooler to the hotwell of the condenser.

Building Construction. Because of frequent floods on the Ohio, it was decided to build a deep-pit plant. The operating floor is six feet above the highest flood level ever recorded for the location. Fill around the foundation is graded to just below the operating-floor level. The water-intake tunnel is low enough to insure continuous supply during low-water stages of the river, to as much as 12 feet below the normal level.

A solid concrete foundation resting on shale makes up the portion of the building including the tunnels, pump room and turbine-generator supports. The shale is relatively level and is about 84 feet below the operating floor. The rest of the building gets its support from steel shells filled with concrete extending to the shale.

Using precast, concrete wall panels bolted to the building's steel frame gave a 35% saving in cost over the conventional 12-in. brick-wall construction. Broom-brushing the exterior surface of these panels gives the building a pleasing appearance. Calking between the panels makes it weather tight.

The concrete panels were fabricated and cured in the shop. Each panel is 8x8 feet and 5 inches thick. There is an internal insulation core 1½ in. thick. This core gives the power-plant walls better insulating qualities than would the conventional brick wall. The panels can be erected quickly—about 2500 sq ft per day with one operating rig.

On the west side of the plant, window frames and casings are made of stainless steel to ease maintenance problems.

Design, Construction. Plant design and construction supervision was by Ford, Bacon & Davis Inc, and the Electro Metallurgical Engineering Dept.

PRINCIPAL POWER-PLANT EQUIPMENT: ELECTRO METALLURGICAL CO., MARIETTA, OHIO

POWER-GENERATING EQUIPMENT:

Turbine-generators, 4 ..... General Electric Co
Turbines: 40,000 kw, 3600 rpm, 1250 psig, 950 F, 1.5-in.-Hg abs back-pressure, tandem compound. 180,000 lb per hr at 330 psig to process from single automatic extraction point. Generators: 3-phase, 0.8 pf, 60 cycle, 13,800 v, hydrogen cooled

Condensers, 4 ..... Allis-Chalmers Mfg Co
30,000 sq ft, 2-pass, horizontal surface

Circulating-water pumps, 8 ..... Allis-Chalmers Mfg Co
Horizontal, 15,000 gpm each, 27-ft head at 495 rpm

Circulating-water pump drives, 8 ..... Allis-Chalmers Mfg Co
125 hp, 2500 v, 60 cycle, 3-phase

STEAM-GENERATING EQUIPMENT:

Boilers, 4 ..... Babcock & Wilcox Co
Radiant, single drum, dry bottom, 650,000 lb per hr at 1325 psig and 950 F, 53,600-cu-ft furnace with 12,555-sq-ft heating surface, pulverized-coal fired. Each boiler has: 1 continuous loop superheater; 1 economizer with 18,766 sq ft of 2½-in. tubes; 12 burners; 4 pulverizers: 22,300-lb-per-hr 50 grindability, 75% through 200 mesh, 150-hp 600-rpm motors

Air preheaters, 8 ..... Air Preheater Corp
Regenerative, cold-end elements arranged in baskets.

Soot blowers, 14 per boiler ..... Diamond Power Specialty Corp
Air, 6 retractable for superheater, 8 revolving for economizer

Forced-draft fans, 8 ..... Sturtevant Div, Westinghouse Electric Corp
82,400 cfm, 80 F, 7.4 in. water, 1200 rpm, watercooled bearings

Forced-draft fan motors, 8 ..... Allis-Chalmers Mfg Co
200 hp, 1200 rpm, squirrel-cage induction

Induced-draft fans, 8 ..... Sturtevant Div, Westinghouse Electric Corp
150,000 cfm, 281 F, 10.5 in. water, 700 rpm, watercooled bearings

Induced-draft fan motors, 8 ..... Allis-Chalmers Mfg Co
500 hp, 700 rpm, squirrel-cage induction

Primary air fans, 4 per boiler ..... American Blower Corp
21,600 cfm, 510 F, 25.5 in. of water, 1800 rpm

Primary air-fan motors, 4 per boiler ..... Allis-Chalmers Mfg Co
200 hp, 1800 rpm

Ash hopper, 4 ..... Allen-Sherman-Hoff Co
Dry type, ash removal by high-velocity water jets to sluiceway

Ductwork and stacks ..... Connery Construction Co

FEEDWATER EQUIPMENT:

Hotwell pumps, 2 per unit ..... Allis-Chalmers Mfg Co
3 stage centrifugal, 850 gpm, 545-ft head. 200-hp 480-v 60-cycle squirrel-cage induction motors

Air ejectors, 1 per unit ..... Allis-Chalmers Mfg Co

Low-pressure feed heaters, 3 per unit ..... Westinghouse Elec Corp
1 horizontal drain cooler, 2 vertical heaters, ⅝-in OD arsenical-copper tubes. Total surface 3485 sq ft

Deaerating heater, 1 per unit ..... Elliott Co
650,000 lb per hr, vertical, spray tray

Boiler feed pumps, 3 per unit ..... Byron Jackson Co
650,000 lb per hr of 53-psig 300-F water, 1860-psig discharge, 3600 rpm, barrel type, 9 stage. Two, motor driven; one spare, steam driven

Boiler feed-pump drives, 2 per unit ..... General Electric Co
1750-hp 3600-rpm 2300-v 3-phase 60-cycle drip-proof horizontal squirrel-cage induction motors

Boiler feed-pump drive, 1 per unit ..... Worthington Corp
1750-hp 3580-rpm horizontal single-stage noncondensing steam turbine. Steam at 1250 psig, 950 F, with 0-50 psig backpressure

High-pressure feed heaters, 2 per unit ..... Westinghouse Elec Corp
Vertical U-tube bundles, ⅝-in. OD 70-30 cupro-nickel tubes. Total surface 5950 sq ft

Condensate-transfer pumps, 2 per unit ..... Ingersoll-Rand Co
600 gpm, 470-ft total head, 2-stage centrifugal, horizontal-split-casing pumps. 100-hp, 440-v, squirrel-cage induction motors

INSTRUMENTS AND CONTROLS:

Combustion controls ..... Hagan Corp
Feedwater control, 3-element ..... Bailey Meter Co
Boiler feed-pump bypass control ..... Republic Flow Meters Co
Level and flow control valves ..... Fisher Governor Co
Utiliscope television system ..... Diamond Power Specialty Corp
Pressure gages ..... Helicoid Gage Div, American Chain & Cable Co
Thermometers:
Indicating ..... Palmer Thermometers, Inc; Philadelphia Thermometer Co; Bailey Meter Co
Thermometers: Recording, alarm ..... Brown Instrument Div, Minneapolis-Honeywell Regulator Co; Hagan Corp; Leeds & Northrup Co; Manning, Maxwell & Moore, Inc
Pressure-reducing valves ..... Fisher Governor Co; Republic Flow Meters Co
Pressure alarms ..... Mercoid Corp
Level indicators, recorders and alarms ..... Bailey Meter Co; Diamond Power Specialty Corp; Jerguson Gage & Valve Co; Magnetrol, Inc; Mason-Neilan Regulator Co
Draft gages ..... Republic Flow Meters Co
pH recorder ..... Cambridge Instrument Co
Oxygen recorder ..... Cambridge Instrument Co
CO₂ recorder ..... Leeds & Northrup Co
Smoke-density recorder ..... Bailey Meter Co
Conductivity recorder ..... Brown Instrument Div, Minneapolis-Honeywell Reg Co; Industrial Instruments, Inc
Flowmeters: Indicating and recording ..... Bailey Meter Co; Hagan Corp; Penn-Industrial Instruments Co; Republic Flow Meters Co
Boiler and turbine boards ..... Falstrom Co
Desuperheaters ..... Republic Flow Meters Co
Annunciators ..... Panalarm Products Inc

VALVES:

Solenoid valves ..... Automatic Switch Co
Heater nonreturn valves ..... Atwood & Morrill Co
Safety and relief valves ..... Crosby Steam Gage & Valve Co; Foster Engineering Co; J E Lonergan Co; Manning, Maxwell & Moore, Inc.
Attemperator regulating valves ..... Bailey Meter Co
Hotwell-pump recirculation valves ..... Kieley & Mueller, Inc
Instrument valves, high pressure ..... Edward Valves, Inc
Instrument valves, low pressure ..... Crane Co
High-pressure valves ..... Crane Co; Edward Valves, Inc
Butterfly valves ..... R S Products Corp
Low-pressure valves ..... Chapman Valve Mfg Co; Crane Co; Walworth Co
Steam traps ..... Armstrong Machine Works; Velan Engineering Co
Chlorination system ..... Builders-Providence, Inc

ELECTRICAL EQUIPMENT:

Main transformers, 3 ..... Westinghouse Electric Corp
6000/8000/10,000 kva, 132/13.8 kv, single phase

Outdoor substation, 132 kv ..... R&IE Equip Div, ITE Circuit Breaker Co

Unit auxiliary transformers, 12 ..... Allis-Chalmers Mfg Co
2500 kva, 13,800/2400-v, 3-phase

Auxiliary transformers, 8 ..... Allis-Chalmers Mfg Co
1000 kva, 13,800/480 v, 3-phase

Isolated phase bus, 13,800 v, 3 ph ..... ITE Circuit Breaker Co

13,800-v switchgear ..... Westinghouse Electric Corp

2400-v and 480-v switchgear ..... ITE Circuit Breaker Co

Main electrical control benchboard, meter and relay boards ..... Westinghouse Electric Corp

COAL-HANDLING EQUIPMENT:

Derrick on dock ..... Clyde Iron Works, Inc
Stiff-leg derrick with 70-ft boom and 2-yd bucket. Driven by 100-hp 900-rpm 3-phase 60-cycle 220-v motor. Used for barge unloading

Belt conveyor ..... Jeffrey Manufacturing Co
From dock to car shed. 24-in. 5-ply 350-fpm belt at 14-deg incline. Driven by 20-hp 3-phase 60-cycle 440-v motor with reducer. Handles 175-tons-per-hr 8-in. or under coal

Belt conveyor ..... Jeffrey Manufacturing Co
Car shed to crusher house. 42-in.-wide 7-ply 400-fpm belt at 14-deg incline. Driven by 75-hp 1800-rpm 3-ph 60-cycle 440-v motor with reducer. Handles 8 in. or under coal.

Boom conveyor ..... Jeffrey Manufacturing Co
Crusher house to coal pile. 42-in.-wide 4-ply 200-fpm belt. Driven by 7½-hp 1800-rpm motor with reducer. Handles 325-tons-per-hr ¾-in. coal

Crusher ..... C O Bartlett & Snow Co
In hopper house. Roll crusher reduces 650-tons-per-hr coal to 6-in. lumps. Driven by 100-hp 720-rpm 480-v motor

Belt conveyor ..... C O Bartlett & Snow Co
Hopper house to crusher house. 42-in.-wide 7-ply 400-fpm belt at 15-deg incline. Driven by 100-hp 1800-rpm, 3-ph 60-cycle 480-v motor with reducer. Handles 6-in., or under coal.

Crusher, 2 ..... Jeffrey Manufacturing Co
In crusher house. Ring crusher to reduce 8-in. coal to ¾ in. Each driven by 200-hp 600-rpm 3-phase 60-cycle 440-v motors

Belt conveyor ..... Jeffrey Manufacturing Co
Crusher house to boiler house. 42-in.-wide 7-ply 400-fpm belt at 14-deg incline. Driven by 100-hp 3-ph 1800-rpm 60-cycle 440-v motor with reducer. Handles ¾-in., or under, coal

Transfer belt conveyor ..... Jeffrey Manufacturing Co
In boiler house. 42-in.-wide 4-ply 400-fpm belt. Driven by 15-hp 1800-rpm motor with reducer

Shuttle belt conveyor ..... Jeffrey Manufacturing Co
In boiler house. 42-in.-wide 4-ply 400-fpm belt driven by ½-hp 1800-rpm motor with reducer. Conveyor speed 150 fpm on 16-lb rail. Driven by 2-hp 1800-rpm motor with reducer

ASH-HANDLING EQUIPMENT:

Mechanical flyash collectors, 4 ..... Aerotec Corp
Draft loss 4 in. of water. Hopper capacity 1470 cu ft for two units and 1200 cu ft for other two

Electrostatic flyash precipitators, 4 ..... Koppers Co
370,000 cfm, 320 F, 95% efficiency with draft loss of 0.45-in. water. 4 fields (2 inlet, 2 outlet). Hopper capacity 3100 cu ft

Ash conveying ..... United Conveyor Corp
Pneumatic sequentially controlled from stack and flyash hopper, both sluiced to ash pond

MISCELLANEOUS EQUIPMENT:

Soot-blower compressors, 4, 2-stage, water-cooled, 500 cfm at 500 psig ..... Chicago Pneumatic Tool Co; Worthington Corp
Belt driven by 200-hp 875-rpm 3-phase 60-cycle 440-v motors

Plant air compressors, 3, 2-stage, water-cooled, 2600 cfm at 100 psig ..... Chicago Pneumatic Tool Co; Worthington Corp
Directly driven by 500-hp 225-rpm 3-ph 60-cycle 2300-v motors

Instrument air compressors, 2 ..... Nash Engineering Co
Single stage, 110 cfm at 90 psig, directly driven by 50-hp 1750-rpm 3-phase 60-cycle 440-v motors

Service water pumps, 11 ..... Ingersoll Rand Co
Single stage, volute centrifugal, 10,000 gpm, 280-ft total discharge head. Direct drive by 800-hp 1200-rpm 2300-v motors

Traveling screens, 5 ..... Link Belt Co
10 ft wide by 71 ft deep, No. 14 W & M gage, galvanized steel wire with ⅜-in. openings, speed 10 fpm to pass 36,666 gpm

Water-treating systems, 2 ..... Graver Water Conditioning Co
Capacity of 240 gpm each. Zeolite systems, each consisting of: 1 sludge blanket clarifying unit, 2 gravity filters, 1 clearwell, 2 transfer pumps, 3 zeolite softeners, 2 backwash pumps

Makeup evaporators, 5 ..... Westinghouse Electric Corp
2400-sq-ft horizontal submerged bundle, bent tube, thermal descaling, vapor-washing spray-makeup system, scale-agitating jets. Capacity 40,000 lb per hr each at 28 psig, 271 F. Tubes 80-20 copper-nickel

Makeup evaporator preheaters, 5 ..... Elliott Co
55,195 lb per hr, spray tray, vertical, direct-contact preheaters

Chemical-feed treatment ..... Orlich Brothers Machine Works
Each boiler has the following: 3 caustic and sulfite pumps, 2 gph at 2000 psig discharge; 1 pump for 5% trisodium phosphate, 30 gph

OLD WAY: Awkward 50 feet

NEW WAY: Easy arm's length

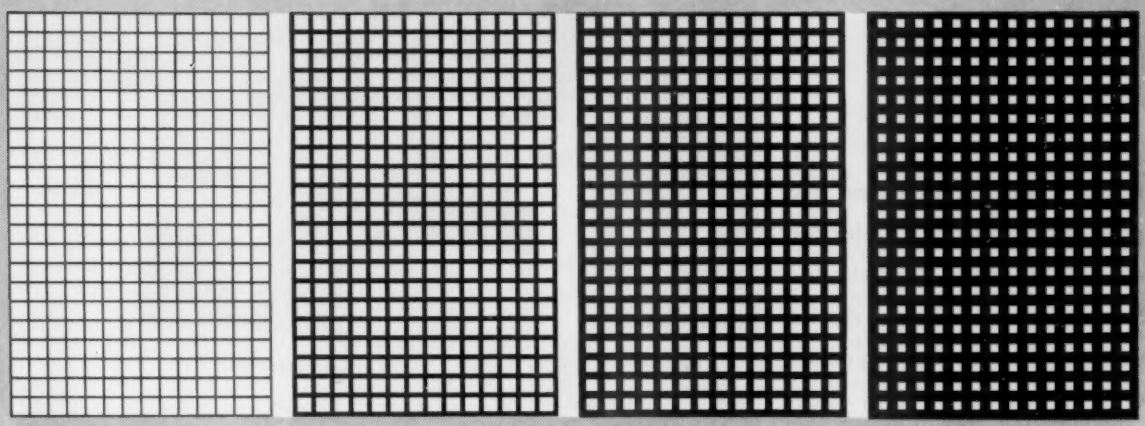
The Ringelmann Chart is today's most firmly established standard for visual smoke measurement, but inspectors don't like having to hold it at 50 feet. Our answer is . . .

Power's MicroRingelmann: A New Aid to Smoke Inspectors

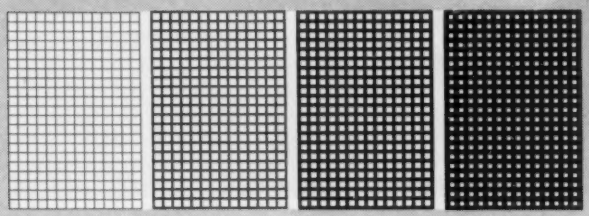
► MANY PEOPLE ARGUE that the Ringelmann Smoke Chart is not a solution to the problem of air pollution, and they are quite right. But they go on to say that it is not even a valid device for gathering evidence against violators of smoke ordinances. Against this last argument stands the hard fact that many cities still base their laws on this chart. And the courts still try offenders on the basis of evidence backed by it.

The big question today seems to be: "How did such a supposedly inadequate device manage to gain such wide importance in the field of smoke measurement?" For an answer to this, let's check back and see how it all started.

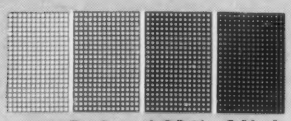
During the late 1800's, Maximilien Ringelmann, a French professor, developed this system of grids of varying tone values for the purpose of visually measuring various densities of smoke. The chart first entered the United States in an article written by William Kent and published in *Engineering News* of November 11, 1897. Even at this early date, the Ringelmann was enjoying rather ex-



Standard Ringelmann Chart reduced 73%; view at 14 ft



Standard reduced 86%; 7 ft



Reduced 93%; 3½ ft

Viewing distance varies with size

These three sets of grids are direct photographic reductions of the standard Ringelmann Chart. They show strikingly how tonal quality of tints depends on ratio of black to white, not on the thickness of the lines themselves.

tensive use in Europe. In 1899, Kent proposed that it be accepted as the standard measure of smoke density in the standard code for power-plant testing that was being formulated by the American Society of Mechanical Engineers.

Engineers of the U.S. Geological Survey (which later became the nucleus of the U.S. Bureau of Mines) used the chart in their studies of smokeless combustion starting at St. Louis in 1904. By 1910, the Massachusetts Legislature had officially recognized the Ringelmann Chart in a Boston smoke ordinance and, since that time, cities all over the country have been using it as the backbone of their smoke-control laws.

In devising his chart, Ringelmann's aim was to achieve some reproducible standard for comparing shades of gray. However, limited by technical difficulties of that day, he had no choice but to make his grids large enough so that specified proportions of black to white could be maintained with relatively simple drafting methods. The result was the cumbersome set of extremely coarse grids enjoying such wide use today.

Ringelmann's Specifications

Professor Ringelmann's own instructions for reproducing his cards are as follows:

Card 0—all white

Card 1—black lines 1 mm thick, 10 mm apart, leaving white spaces 9 mm square (This produces a grid surface that is 20% black)

Card 2—lines 2.3 mm thick, spaces 7.7 mm square (40% black)

Card 3—lines 3.7 mm thick, spaces 6.3 mm square (60% black)

Card 4—lines 5.5 mm thick, spaces 4.5 mm square (80% black)

Card 5—all black

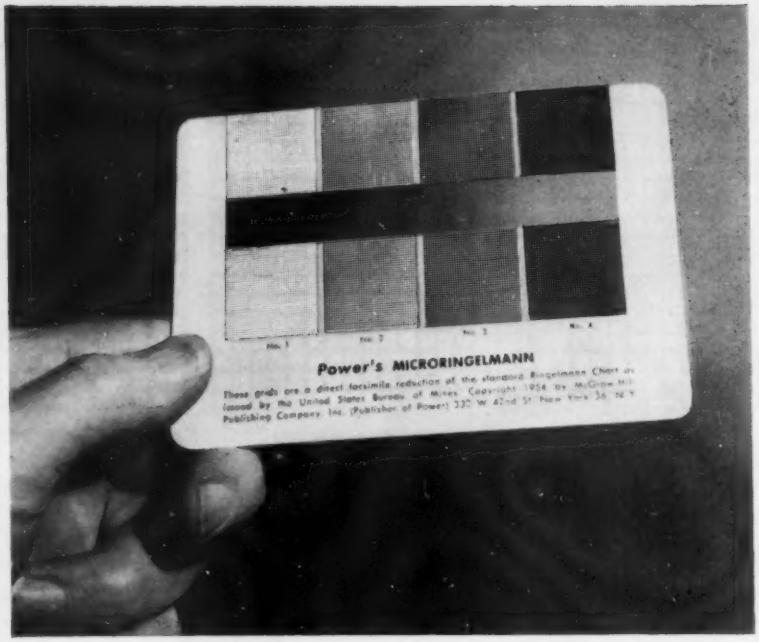
Instructions accompanying this chart, and presented in full detail in Bureau of Mines Circular 6888, tell the user to "hang smoke chart on a level with the eye, about 50 feet from observer, as nearly as possible in line with chimney. Observer glances at smoke as it issues from chimney, notes number of chart most nearly corresponding with shade of smoke and records this number with time of observation. . . ."

From these specifications, it is easy to see that the chief asset of the Ringelmann is its ability to preserve, easily and with sufficient accuracy, predetermined proportions of black and white. When viewed at a distance great enough for the lines to merge visually, a distance considerably more than 50 feet, these grids will appear as specific and unvarying shades of gray.

To test the validity of this argument, hold the above grids at a distance sufficient to make the largest set of lines merge. Notice that the tonal values in each corresponding grid are precisely the same even though the individual lines vary considerably in thickness and spacing. The optical principle underlying this effect is simple. If any regular grid of black lines on white is held far enough from the eye for the lines to "fuse," the eye sees a uniform shade of gray. The degree of grayness depends only on the ratio of black area to white.

Continued on next page

Power's MicroRingelmann is a precise photographic reduction of the standard Ringelmann Smoke Chart. This new device will provide smoke inspectors with a convenient and accurate method for detecting violations of smoke ordinances



New device for visual smoke measurement

Precise photographic reduction affects all areas equally, and so retains the original shade in a grid that will merge into a gray tint much closer to the eye.

Of course, there is a limit to this reducing process: a point at which the process begins to introduce an appreciable percentage error in line width with a resulting error in tone value.

For his day, Ringelmann was very practical. He designed a grid so coarse that it could be laid out accurately by an ordinary draftsman working with specified line widths and spacings.

Scientifically, no more reliable visual standard of smoke measurement has ever been devised, but the extreme coarseness of this simple grid has proved an enormous handicap in everyday field use. The need to hold the chart at least 50 ft from the eye, and, at the same time, in line with the smoke, has imposed an intolerable burden on busy smoke inspectors.

Quite naturally, they have often followed the "practical" procedure—left their Ringelmann Chart at the office and estimated smoke density from memory. Common sense tells us that such estimates, made by experienced inspectors, are relatively accurate. But experience shows that such accuracy rarely satisfies a court of law. Many actual violators of smoke laws have been let off because the accusing inspector did not follow the letter of the law. (POWER, *December 1953, page 106*).

To give the Ringelmann everyday usefulness, POWER has developed, after much experimenting with photographic and engraving techniques, a notably precise reduction of the original. As shown in the above photo, this new chart, the MicroRingelmann, incorporates several extremely helpful improvements.

Advantages of the MicroRingelmann

First, these grids are true Ringelmann charts reduced to 1/19 original size. This means that the new chart may be used, in line with Bureau of Mines specifications, at a distance of about 2½ feet, or average arm's length. Also, the user of this convenient card can place his grids right in line with the smoke being examined and, by comparing densities through the slot provided, get a more accurate reading than he could with the old Ringelmann. At the moment the observer is looking at the smoke through this slot, the surrounding grids will merge with the smoke into one continuous tone of gray. Also, the card itself will cut out any distracting background that might confuse the observer and otherwise affect readings.

On the back of each MicroRingelmann are the following detailed instructions adapted from Bureau of Mines Circular 6888 and designed to aid inspectors in the proper use of the card:

1. Hold chart at arm's length and view smoke through slot provided.

2. Be sure that light shining on chart is the same light that is shining on smoke being examined; for best results, sun should be behind observer.

3. Match smoke as closely as possible with corresponding grid on chart.

4. Enter density of smoke (designated by number under each grid) on record sheet; also enter time of each observation.

5. Repeat observations at regular intervals of ¼ or ½ minute.

6. To compute smoke density, use the formula:

$$\frac{\text{Equivalent units of No. 1 smoke} \times 0.20}{\text{Number of observations}} = \text{percentage smoke density}$$

7. Note and record distance to stack, direction of stack, shape and diameter of stack, speed and direction of wind.

At the top of page 93 is a typical record sheet that shows the manner in which observations should be noted. With these data, any smoke inspector will have an ironclad case. And his readings will be true Ringelmann readings.

There has been much talk about the inadequacies of the Ringelmann Chart. These arguments must be considered,

Location 59th & Columbia Ave. Hour 9:00–10:00 A.M. Date Feb. 21, 1954

9

	0	1/4	1/2	3/4	/	0	1/4	1/2	3/4
0	-	-	-	-	30	/	/	/	/
1	-	-	-	-	31	/	/	/	/
2	-	-	-	-	32	-	-	-	-
3	/	/	/	/	33	-	-	-	-
4	/	/	/	/	34	-	-	-	-
5	2	2	2	2	35	/	/	/	/
6	2	3	3	3	36	/	/	/	/
7	3	3	3	3	37	/	/	/	/
8	2	2	/	/	38	/	/	-	-
9	/	/	-	-	39	-	-	-	-
10	-	-	-	-	40	-	-	-	-
11	-	-	-	-	41	-	-	-	-
12	-	-	-	-	42	-	-	-	-
13	-	-	-	-	43	-	-	-	-
14	-	-	-	-	44	/	/	2	2
15	-	-	-	-	45	2	2	3	3
16	-	-	-	-	46	3	3	3	3
17	-	-	-	-	47	3	3	4	3
18	-	-	-	-	48	2	2	2	2
19	2	2	2	2	49	2	2	2	2
20	2	2	2	2	50	2	/	/	/
21	2	2	2	2	51	/	/	/	/
22	3	3	3	3	52	/	/	/	-
23	3	4	4	4	53	-	-	-	-
24	4	5	5	5	54	-	-	-	-
25	5	5	5	5	55	-	-	-	-
26	4	4	3	3	56	-	-	-	-
27	3	3	3	3	57	-	-	-	-
28	2	2	/	/	58	-	-	-	-
29	/	/	/	/	59	-	-	-	-

Point of observation: 59th & Amsterdam Ave.

Distance to stack .... 1200 ft.

Direction of stack ... N.E.

Direction of wind ... N.W.

Velocity of wind ... 30 mph.

		Equiv. No. 1 Units
7	Units No. 5	35
7	Units No. 4	28
27	Units No. 3	81
34	Units No. 2	68
52	Units No. 1	52
113	Units No. 0	0
240	Units	264

$\frac{264}{240}$ X 20% =

22% Smoke density

Observer. J. J. McCloskey

Checked by B. C. McCloud

Typical record sheet to be filled out by inspectors while making observations with the aid of the MicroRingelmann. This is the sort of evidence the courts invariably look for when trying cases under existing air-pollution control ordinances

for, if they are valid, they will apply equally well to the MicroRingelmann.

Fundamentally, the objections to the Ringelmann are based on two points, both of which are true but of minimum practical importance. Point one is that the Ringelmann Chart is seen entirely by reflected light, whereas part of the light coming to the observer from the smoke may be transmitted light. Point two, closely related, is that the quantity of this transmitted light depends on the thickness of the smoke stream.

Experiments proving these points usually involve very small models: real smoke from toy chimneys or tinted water in test tubes of varying diameter. In both cases, variation of apparent density of smoke with diameter shows that transmitted light is an important factor. However, similar experiments will show quite different results when they involve stacks of industrial size.

Actual field tests show that neither ordinary background illumination nor stack diameter have an appreciable effect when the smoke is of No. 3 Ringelmann density. This type of smoke is so dark that there is little doubt as to the violation of a particular ordinance.

On the other hand, when the smoke is of No. 1 Ringelmann density, there can be an appreciable error resulting from stack diameter and background lighting. But few inspectors are worried about such smoke since most ordinances permit emissions of this density.

The big problem comes up when No. 2, or slightly denser smoke, is in question. But the problem here is merely one of eliminating error factors in reading. And such factors can be eliminated. If the stack is sufficiently thick, the error resulting from light coming through the smoke from the background will drop to a negligible level. To further reduce this error, the inspector need only be sure that his major source of light is behind him and that there are no outstanding extremes in background lighting. Following these procedures, he will be treating the predominant factors controlling Ringelmann readings and will be maximizing his accuracy.

Why is the Ringelmann still used?

Admittedly, some criticisms that have been leveled at the Ringelmann Chart have a certain measure of validity. But the big question is: Why, then, can't there be a better method devised for smoke-density measurement? The answer to this lies in the following four points:

1. The Ringelmann Smoke Chart, despite its shortcomings, is a simple and inexpensive device.

2. This chart can be reproduced with sufficient accuracy and in accordance with fixed standards.

3. So far, no one has been able to produce a superior visual standard.

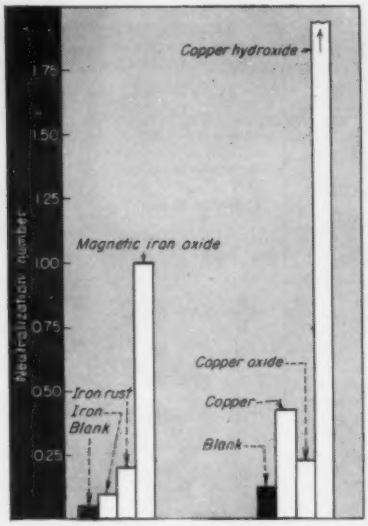
4. The chart is firmly entrenched in many legal codes designed for controlling air pollution. One that is typical reads in part:

"Section 7. The Ringelmann Chart. The standard by which the density of smoke is to be measured will be the Ringelmann Chart, published by the United States Bureau of Mines with instructions for use which is hereby made a part of this ordinance as if the same had been recited herein at length. The Ringelmann Chart as published by the United States Bureau of Mines is attached hereto and made a part hereof. . . ."

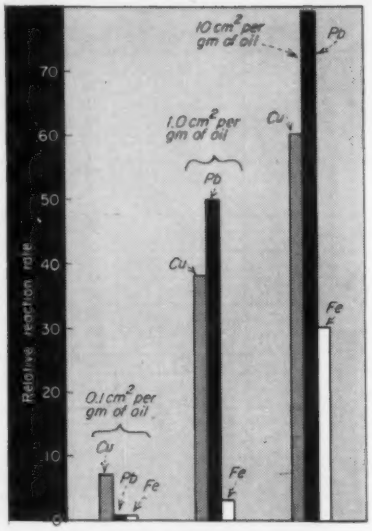
With such firm legal anchoring as this, it would seem that the Ringelmann, whether we like it or not, is here to stay. POWER feels that the MicroRingelmann is a valid—and legal—form of the Ringelmann itself. It removes one of the serious objections to the original chart while still preserving all its advantages. Properly used, this new device should serve both industry and law-enforcement officials as a fair and honest means of smoke measurement. Although, in itself, it cannot eliminate the air-pollution problem, it certainly can help control it.

POWER has a limited number of these MicroRingelmanns available for distribution. Since we are anxious to field-test this new chart, we plan to send one chart, without charge, to any person actively engaged in smoke-abatement work. Persons interested should address their requests to The Editor, POWER, 330 W 42nd St, New York 36, New York.

Chemical stability, which affects the workable life span of an oil in service, hinges largely on materials met up with and the ability to resist oxidation attack. Here are oil reactions you get with many materials



MINERAL OIL shows neut-number change when exposed to metal samples at 200 F



VARYING AREA of metal samples exposed shows difference in reaction time

Is Life of Your Lube Oil Too Short?

► IN THE COURSE of everyday industrial lubrication, oil meets up with many compounds and metals that influence its life span. An oil will contact lube equipment, bearings, gears, journals, water, process materials. In an internal combustion engine the oil faces up to combustion products, plus the above.

Many materials an oil meets in service are harmless to its chemical stability while others, such as some metals, metallic compounds, water and gases, have an adverse effect.

Metals. Antimony, cadmium, chromium, copper, iron, lead, manganese, mercury, silver and tin are common metals that have a catalytic effect on oil oxidation. Of this group, copper, iron and lead are most frequently concerned. The effect of such metals on oil is a function of factors like temperature, time, surface area and type oil.

Although we often assume a temperature rise will increase the reaction rate it does not always hold true in metal-catalyzed oil oxidation. Catalytic activity of three metals may be rated copper-lead-iron at 250 F, but at 175 F the order may well be copper-iron-lead. Some tests indicate that at higher temperatures, say 450 F, non-ferrous metals become inactive and may be anticatalytic.

Exposure time is also important. Copper, when fresh, is quite effective in promoting oxidation. But it does undergo gradual reduction in activity under continued exposure. probably because of surface film present. On the other hand, lead increases potency. This may be traced to lead soaps having high solubility in lube oils, consequently forming little protective film on the metal surface. This prompts increased catalytic activity.

Further tests show three specific oils could be rated in all possible orders of stability hinging on the catalyst present in the test. Such differences may be traced to the type of oxidation products formed or tenacity of their grip on the catalyst surface.

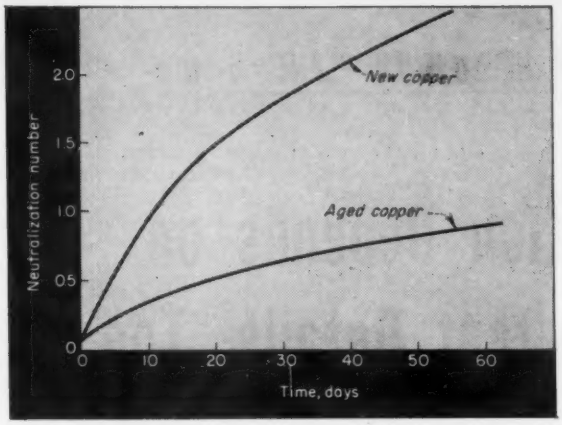
In brief, a catalyst's potency is difficult to evaluate. Further, it points out the pitfalls that stud the path of those attempting to rig up a lab test that must correlate well with field service. At best, results of such a test can serve only as a mere guide for estimating lubricant performance.

Metallic compounds may come about as a result of corrosion, contamination from process materials, equipment components, or as products of fuel combustion. Small metallic particles (fines) are generally present in lube oil as a result of wear in moving parts. Metal oxides frequently found are usually traced to corrosion or rusting.

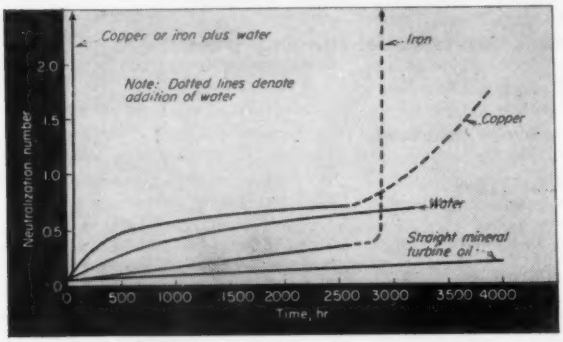
Chart, *above left*, shows results of tests made on an oil containing 1% of dispersed metal or fine oxide particles. The dispersion was maintained by a continuously rotating paddle made of the same metal as the particles being tested. Magnetic iron oxide shows up considerably more active than iron or rust. Copper oxide was not significantly different from the metal itself, but the hydroxide was quite effective in increasing the oxidation rate. Fortunately, hydroxide will be formed only under unusual circumstances. But magnetic iron oxide is found quite often in lube systems.

Study of oxide behavior shows the effectiveness of metal in catalysts is not lost even though no longer in a free state. This effectiveness of metal may be traced to formation of metallic soaps from the oxide. Yet most metallic soaps tend to diminish their catalytic activity with time by being (1) thrown out of solution or (2) rendered inert by formation of metal complexes.

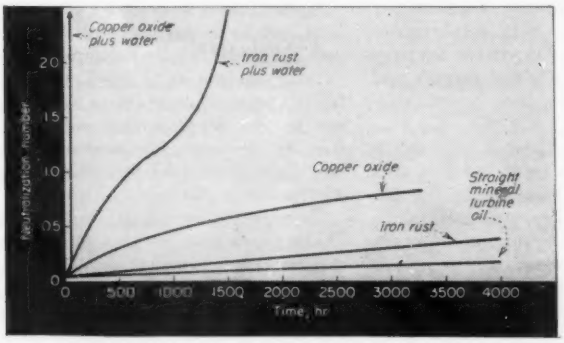
Where metallic soaps are unintentionally present in lube oil, it's generally because of oil deterioration and the combining of deterioration products with metals in the system. Since soluble metal soaps are often more active catalysts than the metals themselves, it is important to exclude them from contact with a fresh oil charge. That's one reason why it's important to clean a system thoroughly before changing the oil fill. Case in point: A heavy circulating oil for a gear system operating at a humid 250 F was, as a matter of prac-



COPPER AGING shows a measurable effect on the oxidation rate of straight mineral oil, laboratory tested at a constant 250 F



NEUTRALIZATION NUMBER takes sharp upward swing if water is added to oil in presence of sample metals. Test run at 203 F



IRON RUST, although greatly activated by water in oil, does not show immediate activity displayed by other combinations

tice, drained at the end of its service life and new oil added. But on one occasion when the old deposits were flushed out before adding the new oil, life of the lubricant was increased fourfold.

Water is probably the most frequent contaminant found in lube systems. In addition to impairing the lubricating quality of the oil and causing corrosion of metallic parts it has a significant influence on an oil's chemical stability.

Effect of water on rate of oxidation is shown in center curve.

By **CLAYTON W NICHOLS, JR,** *Technical Service Dept*
Socony-Vacuum Oil Company, Inc

The nearly vertical line at extreme left is the normal behavior of a noninhibited oil in the standard ASTM test, using copper and iron catalysts in the presence of water. Note that deterioration occurs at a fast rate.

Curves for dry metals bring out clearly that iron increased the rate of oil oxidation while copper was even more effective. Then when rate became stable, water was added. Dotted portion of curves indicates the subsequent reaction pattern. Iron reaction was immediate, like that of a fresh metal. Note in the presence of copper the oxidation rate turned sharply upward but was evidently held back somewhat by a protective film on the metal.

Oxides show the same general trend, *bottom curve.* It's interesting to note that iron rust, while greatly activated by water, does not have the immediate activity shown by the other combinations. Water combined with copper oxide led to rapid oil deterioration, but when united with aged copper it did not, *curves left, center.* It's highly probable that an organic film rather than an inorganic oxide is responsible for deactivation of copper in service.

Gases. Some gases markedly affect oil stability. The most potent probably is nitrogen dioxide with chlorine running not far behind. In the power field these gases are not generally met as factors in lubrication except in connection with the compressors handling them. Here are some effects on a solvent-refined turbine oil exposed to gas for one week at −70 F: In the case of nitrogen dioxide, oil viscosity at 100 F showed an increase of 11.2 ssu and a neutralization number increase of 1.2. With chlorine, viscosity increased 7.9 while neutralization number went up 0.6.

Oxidation inhibitors are added to lube oils to counteract normal oxidation processes and the catalytic activity discussed above. They act in two ways. First, to stop the chain reaction started by hydroperoxide. Inhibitor does this by changing the free radical to an inactive form, yet does not destroy its own activity. Additive may be gradually depleted but normally this is not an important factor.

Second mode of action is by bulk metal deactivation. This can be accomplished either on the bulk metal or the dissolved soap.

Inhibitors have their temperature limitations; some are effective at high levels, others at low. In turbine oils, for example, where operating temperatures rarely go over 160-180 F, additives are used that are entirely different from those in internal-combustion engine oils.

From above curves and discussion, it is quite evident that oil oxidation is affected catalytically by different compounds and elements. There is a wide spread in potency of these agents that depends on conditions under which the reaction takes place. However, because of the extremely complex nature of petroleum lubricating oils, any tests designed to evaluate their stability against oxidation must be quite specific. And results of any such tests must be used with discrimination and an understanding of their significance.

HOW TO ORGANIZE YOUR NEW POWER PLANT—6

Topnotch Operation Depends on Checking All-Important Details, Too

Here's expert advice on planning and handling water, lubrication, storage space, spare parts, waste-disposal systems. Follow these practical suggestions for a sweet-running plant

By D C SWIFT, *Ebasco Services Incorporated*

► BESIDES PERSONNEL, buildings, boilers and fuel discussed earlier in this series, a power plant needs the essentials mentioned above. In addition, records and test programs must be set up to keep track of operations. Here's a roundup of these important items:

Water and steam are the mediums through which much of the plant cycle operates. Water is also employed for condenser, bearing and miscellaneous cooling, as well as for drinking, sanitary use and fire protection. This wide application makes it important to maintain plant water in a noncorrosive, nonscale-forming condition.

If water produces corrosion or erosion, it shortens life of equipment. If it forms scale or leaves other deposits, it may have any number of undesirable effects. Heat transfer slows down in condensers, heaters and boilers; tube failures increase; steam flow through turbine blades is reduced; superheater tubes may deteriorate or fail; safety devices may operate improperly, if at all.

Water treatment varies widely with water characteristics. An elaborate treatment system may call for additional operators, supervision and test personnel, as well as the chemicals and equipment for the treatment process.

Lubricating the moving parts lengthens their life and reduces maintenance costs. Plant reliability and availability improve, too, because there are fewer unexpected bearing failures or emergency rebuilding jobs.

Select lubricants to suit the requirements of each bearing, gear, etc. Consider speed, load, temperature, type of bearing, and exposure to moisture and dirt. Also think about method of cooling lubricant and amounts of heat the lubricant has to remove. For effective selection, cooperate with a lubrication engineer from some reputable company with a full line of oils and greases, and with offices and warehouses close to your plant.

Having determined what lubricant is to be used at each point, see that it is applied regularly in adequate but not excessive amounts. Prepare a lube schedule for each unit of equipment. Then see that operators follow the schedule, checking off each point in turn.

Assign one or two men to take care of all lubrication. This assures familiarity with lubricants and lubrication procedures and also places responsibility more definitely in case of trouble.

Keep oils and greases in plainly marked dirtproof containers. Store in a special room that is clean, fireproof and convenient to the plant. And, if possible, reserve a special gun for each kind of lubricant.

Some plants use special fittings for each type of grease, so no one can apply the wrong grease by mistake.

Wipe off the oil-fill covers and grease fittings to keep dirt out of bearings and oil reservoirs. Remember that too much lubricant is almost as bad as too little, because oil or grease overflow may deteriorate motor insulation or other elements of a machine. And keep in mind that machine operation will affect the oil-reservoir level.

Be careful not to overfill ball or roller bearings, as overheating will probably result. Prevent this by removing the cap or plug on bearing-grease space while filling. At each overhaul period, clean and inspect bearings, then relubricate. Use new lubricant after overhaul, except where old oil has been filtered and treated to make it like new.

To assure best results, operate oil filtering systems in accordance with manufacturer's instructions. When filtering unit connects to an oil-system reservoir, place point of filter offtake where dirt and water are most likely to accumulate. And, if you want to avoid severe foaming, don't mix different types of oil.

Check turbine oil periodically to see that it has not unduly deteriorated. Acid neutralization, emulsification and viscosity index tests indicate the condition of the oil. Have your lubricant supplier perform these tests, or run them in the plant laboratory if equipment is available.

Storage space and facilities should be adequate for the material and parts

required for plant operation and maintenance.

A plant using solid fuel should have enough space for at least 90 days' supply, with equipment for economically storing and reclaiming. Bulldozers and carryalls are generally most effective for the larger plants. Keep coal well rolled to avoid heating, and sloped to drain off moisture.

Plants burning fuel oil may find it too expensive to provide storage tanks for a 90-day supply; those burning gas do not generally store fuel on the premises.

Most plants use underground tanks or aboveground tanks surrounded by a dike for storing (1) gasoline for motor car use and (2) light fuel oil for boiler ignition torch supply. These tanks should be some distance from the plant and provided with safety devices to satisfy insurance and local fire-code regulations.

Very flammable items like turpentine, paint and varnish should be stored in a special building or a fireproof section of the main building with an outside entrance. Large batches of turbine lubricating oil generally require special fire-protected enclosures, too.

You may need considerable storage space for water-treatment chemicals. Common power-plant chemicals include lime, alum, phosphate, salt, acid, chlorine, etc. Keep lime dry to prevent caking and deterioration, and store it conveniently close to the point of use. Take precautions to prevent excessive dust when handling any of the dry materials. If dust rises, remove it before it becomes a nuisance or a hazard.

Acid (generally sulfuric acid) must be kept completely dry if it is not to become very corrosive to tanks and piping. Use complete safety precautions in handling, and provide a shower so that a man who comes in accidental contact with the acid can wash quickly.

Chlorine, too, must be stored and handled with rigid observance of safety precautions. Put cylinders in a shaded area outdoors or in a tightly walled room that can be ventilated to remove gas if leakage occurs. Keep gas masks handy, and instruct all operators in their use.

Have on hand enough hydrogen and carbon-dioxide cylinders to permit emptying, refilling and emptying the plant's largest hydrogen-cooled generator. Because of the fire hazard, store hydrogen cylinders outside the plant proper, except a minimum number attached to the machine supply manifold.

Supplies and Spare Parts. Charts and ink for recording devices, log sheets and forms, stationery, wiping cloths, janitor and cleaning supplies, fire-extinguisher refills, etc, must be available at all times. Similarly, keep sufficient laboratory chemicals and supplies on hand.

Institute a system for checking these supplies daily. Designate an order point that will allow order and receipt of new materials before supplies run out, but will not involve carrying an excessively large stock.

Work up a list of spare parts for each machine, using plant experience and manufacturer's recommendations as a guide. Keep these spare parts neatly tagged and arranged in storerooms or protected storage areas. Reorder parts as they are used, and take periodic inventory of spare parts on hand.

Your plant needs a store of general maintenance materials like acetylene and oxygen, welding rods, refractory cement, paint, graphite, gasket material, nails, bolts, and small pipe fittings. Have the storekeeper keep these stocks up to normal. If there is no storekeeper, maintenance foreman can handle the job.

Many companies keep most of their operating and maintenance materials in a separate stores account. Items requisitioned out of stores are charged to the appropriate operating or maintenance account as used. Alternately, materials may be charged to the proper account when purchased. The initial inventory of spare parts is often charged to capital accounts and included in cost of the plant. In some accounting systems, larger units are retired when replaced. Cost of the replacement units is then capitalized.

Waste-disposal problems in steam power plants do not ordinarily become too serious. Cinders, slag and collected flyash represent the largest quantity of material, if the plant burns solid fuel. You can often sell cinders or slag for cinder block aggregate or road sanding material.

If there are areas available near the plant for disposing of flyash collections, you can sluice this material, or carry it out by dump car. For taking it farther away, employ motor trucks, railroad cars or barges.

Smoke, flue gas and uncollected cinders and flyash carried out the plant stacks are distributed over the surrounding countryside. Stack height has an important bearing on distribution of the lighter material. Amount of cinder and flyash output depends on amount of ash in fuel, plant operating load and methods and efficiency of collectors. Be sure that dust collector hoppers are emptied often enough to avoid plugging tubes.

Public demand for a minimum of air pollution is increasing. Where economically feasible, answer this by using (1) fuel low in sulfur and ash, (2) equipment and firing methods that produce a minimum of smoke and flyash, (3) mechanical and electrical dust removers. Also, disperse gas widely through high stacks.

Incinerate trash, waste wood, paper and similar material. Then truck away the ashes and other nonburnable materials remaining. Accumulate metallic waste separately, as you can sell much of it for scrap. If you recondition used parts to a "like-new" state, as far as operation is concerned, it is often cheaper than scrapping and replacing with new parts. This also creates a backlog of fill-in work for maintenance forces.

Water-treatment wastes can be sluiced into sewers or streams if volume is small. For considerable volumes, like sludge from lime or lime-soda softeners or precipitators, let the material accumulate in drying beds. When one bed is filled, run waste to another bed and let the first one dry. Then have the dried material hauled to waste; alternately, it may be saleable as agricultural lime.

Plant records must be reasonably complete for a smooth-running plant. In general, a plant has to keep track of costs, time and wages, purchases of fuel, operating supplies and maintenance materials, stock on hand.

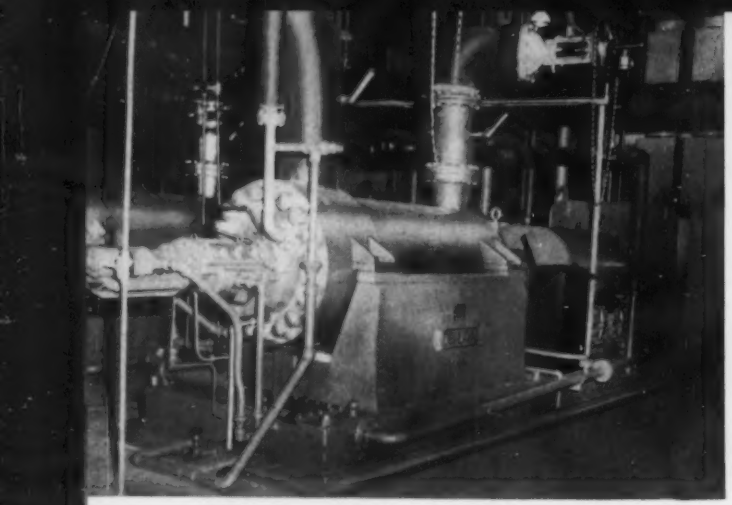
Log sheets, recorder charts, and similar records tell the story of past operation and permit review and comparison with guarantees or operating bogeys. Records of lubrication and maintenance work insure that no part of the plant is neglected and aid in more intelligent and economical maintenance procedures.

Take care that records do not become unduly extensive, detailed or duplicated.

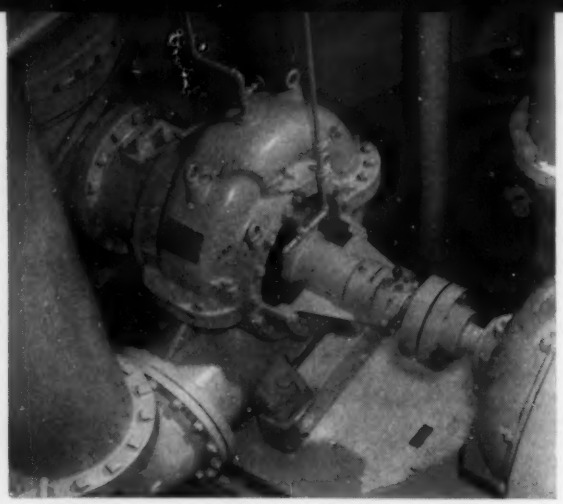
For instance, a record of maintenance work on each piece of equipment is useful, but most plants do not consider the expense warranted of accumulating actual maintenance costs for each unit.

The question of how many readings operators should take has never been resolved. One school of thought holds that taking a large number of readings on scattered instruments will assure that the operator gets to all parts of the plant, and will check equipment and see anything that is not right. A second school maintains that a man wastes time taking a lot of readings that are not going to be used. If the operator is not loaded up taking readings he will have more time and be freer to actually check the equipment.

(Continued on page 206)



BARREL-TYPE FEED PUMP, rated 1400 gpm, 326 F, 2155-psig discharge pressure gives top efficiency in modern station



NEW WATER PUMP in industrial plant: one of six units that have cut operating costs by better efficiency, less upkeep

How Pump Modernization Pays Its Way

...on today's power and industrial jobs

By **E C CONDICT,** *Application Engineer,* and **C E CROMWELL,** *Sales Manager*
Commercial Division, De Laval Steam Turbine Co

► WHEN IS IT ECONOMICAL to replace an old pump with a new one? There isn't one answer that fits every plant, but several helpful guides will allow you to arrive quickly at the solution for your particular installation.

Operating Costs. Take a look at your pumps that are 20 to 30 years old. Their operating costs include power, repairs and depreciation. Perhaps your power is free, the byproduct of some process. Or the units may be fully depreciated. If power and depreciation are negligible (which is seldom the case), you still have repair costs of some kind. Obsolete parts are generally more expensive, and you wait longer to obtain them. If production losses result, they are chargeable to the old units.

Pump Efficiency. Let's take a closer look at the usual plant where power costs must be included as part of the pump operating expense.

A motor-driven pump, built in 1929 to handle 2500 gpm at 150-ft total head, had an efficiency of 78% when new. Input was 121 bhp. Twenty-five years later, in 1954, pump efficiency is about 74%, if no revolving parts have been replaced. Efficiency decrease is traceable to ordinary wear and tear. Power input at lower efficiency is 128 bhp if pump is to run at designed capacity and head.

Today's pump for the same conditions has an efficiency of 85%, requires an input of 110 bhp. This is a possible saving of 18 bhp. Based on a cost of 1c per kwhr, saving in power cost for one year (8760 operating hours) is $1176.

Now let's see how long it would take to pay for a new pump to do the same job the old one does. Table below shows pertinent facts, together with time needed to pay for new unit for several assumed annual operating hours. To this amount must be added freight and the cost of changing the foundation and piping to suit the new pump selected.

Price (estimated) of new pump, base, coupling			$1238
Price (estimated) of 125-hp 440-v 1750-rpm motor			1390
Price (estimated) of a reduced-voltage starter			1170
Total cost of new pump, motor and starter			$3798
Annual operating period, hr.	8760	6500	4000
Time for savings to pay for pump, base and coupling, mo.	13	17	28
Time for complete unit, mo.	39	52	84

Even if renewal parts for the 1929 pump could restore its original efficiency, it would still require 11 hp more than the new pump. Based on 8760-hr operation per year, power cost of old unit is $719 more. Depending on how obsolete the pump parts are, they might be relatively expensive, compared with the cost of a modern pump.

Savings. Suppose you set aside annual power savings so they draw interest. Total amount available is what can be paid for all or part of the cost of a new pump. Where long-term writeoffs are used, the savings could pay for the new unit with enough cash left to justify additional capital expenditures for other equipment.

Operators of some central-station power plants believe that in a new station a unit that pays for itself in eight to ten years is a good investment. When replacing old equipment, the expected life of the plant may reduce the length of write-off that can be considered. This premise must be recognized throughout industry, regardless of the product involved.

Boiler Feed. Here's an example of the 10-year saving possible with a modern pump. Suppose the plant has a pump built in 1930 having an efficiency of 63% and an input of 99.5 bhp. For the same conditions a modern pump (400 gpm, 650-ft total head at 220 F) has an efficiency of 69% and an input of 91.0 bhp. Annual saving if feed pump runs 8760 hr

Operating Data for Old and New Raw-Water Pumps

Year	Old Units: 1948	New Units: 1950
Total power used, kwhr	989,620	703,120
Losses (lights, etc), kwhr	113,340	96,276
Power used by pumps, kwhr	876,280	606,844
Water pumped, gal	6,962,270,000	6,736,090,000
Average flow, mgd	19.3	18.5
Average maximum flow, mgd	22.0	26.7
Average minimum flow, mgd	9.5	10.2
Screenings, cu ft	12,138	7973
Grit, cu ft	5559	12,433
Leaves, cu ft	306	374
Rainfall, in.	48.70	41.76
Rainy days	130	136
Electrical cost, pumping sewage, $	12,905.58	8806.00
Electrical cost, per million gal, $	1.85	1.31

Comparison of Yearly Electric Power Costs

	Old Units	New Units		
	1948	1950	1951	1952
Power, kwhr	876,280	606,844	643,372	694,468
Power costs, $	12,905.58	8806.00	9222.85	9724.44
Million gal pumped	6962.27	6736.09	7232.49	7311.87
Kw per million gal pumped	125.86	90.09	88.96	94.98
Cost per kwhr	$0.0147	$0.0145	$0.0143	$0.0140

per year is $560. If capitalized in 10 years at 4%, total is $6700. Cost of the new pump is $1101.

Pumping Raw Water. An excellent example of the savings possible with modern pumping equipment is offered by an industrial plant handling large quantities of river water containing much grit and solids. While the plant's intake screens remove a portion of the solids, large amounts reach the pumps. Normal wear is accelerated, particularly at points where fluid velocity is high, and at closely fitted wearing rings. Conditions of this kind can introduce many difficult operating and maintenance problems.

Six De Laval vertical 20-in. centrifugal pumps were installed when this plant was built in 1927. Three of the pumps, each rated at 11 mgd, operated at variable speed, being driven by slip-ring motors. The other three, rated at 8 mgd each, were constant-speed units, driven by squirrel-cage motors. All pumps operated against a total dynamic head of 23 ft.

Since excessive wear from unfiltered water was expected, a comprehensive maintenance program was set up at the start of plant operation. Features of the program included checks of pump wear at 2-month intervals and routine overhaul as soon as maximum wear limits were reached. Usual overhaul at 4- to 5-year intervals included replacement of wearing rings, sleeves and bearings.

During the 22-year period from 1927 to 1949, certain minor parts were replaced when their wear became excessive. None of these replacements necessitated removal of the pump from the plant. However, six impellers were shop reconditioned, a job requiring sending the part from the plant for a short time. Service was maintained at all times.

All work except impeller reconditioning was done at the plant by its regular crew. This cut maintenance cost considerably, besides keeping pump at peak efficiency most of the time. In 1948 inspection showed pump casings and valve bodies were so badly worn that it would be only a short time before replacement would be necessary.

New Units. Complete studies of the plant showed that new pumps, motors and controls would give best savings. Obsolescence was an important factor in the studies. For example, the old vertical motors were in good condition but three were variable-speed slip-ring types, requiring frequent replacement of control parts. For this reason, constant-speed operation was preferred. Besides, keeping these motors meant using some 20 ft of shafting for each, another source of maintenance expense and power losses.

Plant power factor was low, a fact that caused the local utility to hint that a charge would be made unless it was raised. Switchgear was old, outdated. Pumps and shafts needed constant attention to see that lubrication was satisfactory.

Six new De Laval centrifugal pumps were chosen to replace the old units. All have 16-in. suction and discharge connections. Three of the pumps are rated 10 mgd; the other three are 8-mgd units. They operate at 600 rpm against a total dynamic head of 19 ft. The three smaller pumps may be run to handle 10 mgd if the need arises. Being horizontal, the new pumps eliminate the need for vertical shafting and its attendant maintenance.

In addition to pump replacement, extensive changes were made in the plant's electrical system. These include new switchgear, controls, feeders, etc.

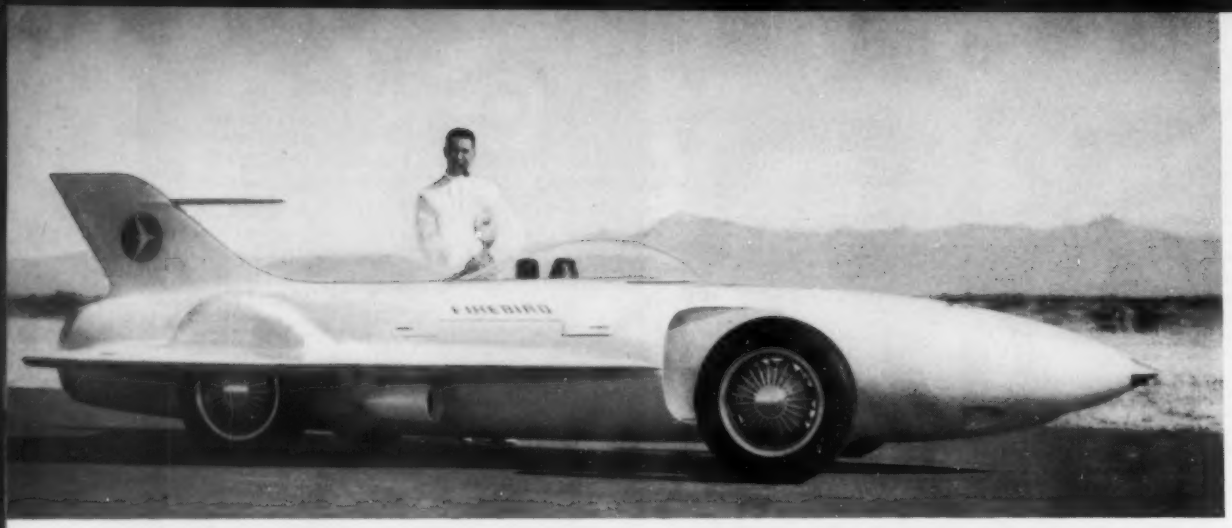
Results. Tables at left show the new pumps have really paid off. Electrical savings alone run about $10 per day when handling 18.5 mgd. Add to this the fewer shutdowns, reduced maintenance and increased accuracy of plant records obtained with the new installation and you have many real advantages.

Careful matching of pump to existing water conditions accounts for part of the success of the installation. This is a factor that requires thorough study every time a new pumping plant is planned for any type of plant.

No. 3 of the Bill Eddy Cartoons

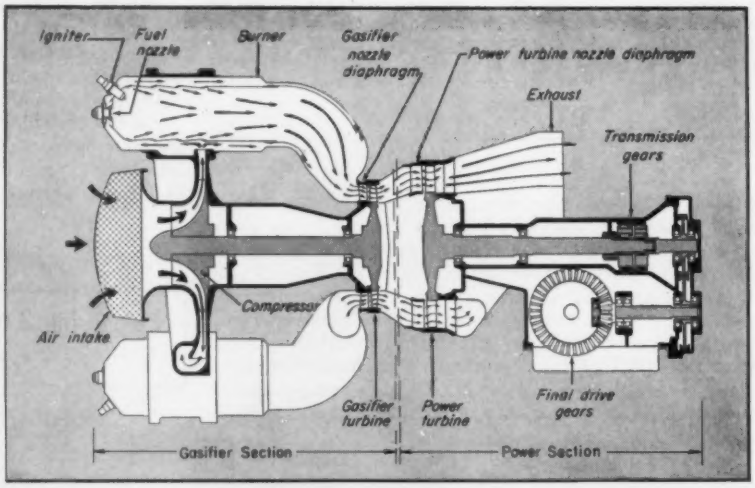
Repeated by request

"Hold it, Norbert, while I go get POWER's Data Sheet No. 77B"



SINGLE-SEATER AUTOMOBILE uses simple-cycle 2-shaft gas turbine burning kerosene for motive power. Unit mounts behind driver's seat, 35-gal fuel tank in front. Simulated jet at rear is convenient method of handling large volume of engine exhaust

GAS TURBINE mounted in auto chassis has centrifugal compressor behind driver



TWO-SHAFT GAS TURBINE uses single-stage centrifugal compressor for 3.5:1 compression ratio. Two burners deliver 1500-F gas to first turbine wheel of unit

370-Hp Gas Turbine Tested on the Road

• General Motors Corp has been testing an experimental gas-turbine car at their proving grounds about four months

• Similar gas turbine is being tested in an experimental bus, using full instrumentation to obtain complete data on engine road performance

► THE SECOND automotive gas turbine to travel on wheels in the U.S. has been announced by the General Motors Corp. A 370-hp simple-cycle 2-shaft gas turbine has been running on the GM proving grounds since last October. A second similar unit is being run in an experimental bus to test it for that type of heavier service.

The unit, shown in schematic section above, burns kerosene and develops a full-load temperature of about 1500 F. A 24-v electrical system starts the engine by "reving" it up to 3000 rpm. The engine idles at 8000 rpm. The power-gas generator or gasifier runs at full-load speed of 26,000 rpm and the power turbine at 13,300 rpm.

Total weight of the engine is 775 lb, making it 2.1 lb per hp. This is about 1/3 the ratio for conventional passenger-car engines. The fuel consumption is reported as "several times" that of conventional cars. The engine consumes about 20 times as much air as a production piston engine.

GM has been studying gas turbines for locomotive drive for the past 3½ years. They are also experimenting with the free-piston gas generator to explore its possibilities as a prime mover in the transportation field.

Power's DATA SHEET

No. 261

Pressure In. Hg. abs (Sat. temp, F)		Moisture, percent 15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
0.5	v	1067.9	1055.4	1042.8	1030.2	1017.7	1005.1	992.6	980.0	967.4	954.9	942.3	929.7	917.2	904.6	892.0	879.5
(58.8)	h	928.4	917.8	907.2	896.6	886.0	875.4	864.8	854.2	843.6	833.0	822.4	811.7	801.1	790.5	779.9	769.3
	s	1.7917	1.7713	1.7508	1.7303	1.7099	1.6894	1.6690	1.6485	1.6281	1.6076	1.5872	1.5667	1.5463	1.5258	1.5054	1.4849
1.0	v	554.5	547.9	541.4	534.9	528.4	521.8	515.3	508.8	502.3	495.7	489.2	482.7	476.2	469.7	463.1	456.6
(79.0)	h	938.9	928.4	917.9	907.4	897.0	886.5	876.0	865.5	855.0	844.5	834.0	823.5	813.0	802.5	792.0	781.5
	s	1.7466	1.7271	1.7077	1.6882	1.6687	1.6492	1.6298	1.6103	1.5908	1.5713	1.5519	1.5324	1.5129	1.4935	1.4740	1.4545
1.5	v	378.2	373.7	369.3	364.8	360.4	355.9	351.5	347.0	342.6	338.1	333.7	329.2	324.8	320.3	315.9	311.4
(91.7)	h	945.4	935.0	924.6	914.1	903.7	893.3	882.9	872.5	862.0	851.6	841.2	830.8	820.4	809.9	799.5	789.1
	s	1.7207	1.7018	1.6829	1.6640	1.6451	1.6262	1.6073	1.5884	1.5695	1.5506	1.5318	1.5129	1.4940	1.4751	1.4562	1.4373
2.0	v	288.3	284.9	281.5	278.1	274.8	271.4	268.0	264.6	261.2	257.8	254.4	251.0	247.6	244.2	240.8	237.4
(101.1)	h	950.2	939.8	929.5	919.1	908.7	898.4	888.0	877.6	867.3	856.9	846.6	836.2	825.8	815.5	805.1	794.7
	s	1.7025	1.6840	1.6655	1.6470	1.6286	1.6100	1.5916	1.5731	1.5546	1.5362	1.5177	1.4992	1.4807	1.4622	1.4438	1.4253
2.5	v	233.7	230.9	228.2	225.4	222.7	219.9	217.2	214.4	211.7	208.9	206.2	203.4	200.7	197.9	195.2	192.4
(108.7)	h	954.1	943.7	933.4	923.1	912.8	902.4	892.1	881.8	871.5	861.1	850.8	840.5	830.2	819.9	809.5	799.2
	s	1.6885	1.6703	1.6522	1.6340	1.6159	1.5977	1.5795	1.5614	1.5432	1.5251	1.5069	1.4887	1.4706	1.4524	1.4343	1.4161
3.0	v	196.9	194.5	192.2	189.9	187.6	185.3	183.0	180.6	178.3	176.0	173.7	171.4	169.1	166.8	164.4	162.1
(115.1)	h	957.3	947.0	936.7	926.5	916.2	905.9	895.6	885.3	875.0	864.7	854.5	844.2	833.9	823.6	813.3	803.0
	s	1.6772	1.6593	1.6414	1.6235	1.6056	1.5877	1.5698	1.5519	1.5340	1.5161	1.4982	1.4803	1.4624	1.4445	1.4266	1.4087
4.0	v	150.2	148.4	146.7	144.9	143.1	141.4	139.6	137.8	136.1	134.3	132.5	130.8	129.0	127.2	125.5	123.7
(125.4)	h	962.6	952.4	942.1	931.9	921.7	911.5	901.2	891.0	880.8	870.6	860.3	850.1	839.9	829.6	819.4	809.2
	s	1.6593	1.6418	1.6243	1.6068	1.5894	1.5719	1.5544	1.5369	1.5195	1.5020	1.4845	1.4670	1.4495	1.4321	1.4146	1.3971
Psia																	
0.5	v	545.2	538.8	532.4	525.9	519.5	513.1	506.7	500.3	493.9	487.5	481.1	474.6	468.2	461.8	455.4	449.0
(79.6)	h	939.1	928.6	918.1	907.6	897.1	886.6	876.2	865.7	855.2	844.7	834.2	823.7	813.2	802.7	792.2	781.8
	s	1.7455	1.7260	1.7066	1.6871	1.6677	1.6482	1.6288	1.6093	1.5899	1.5704	1.5510	1.5316	1.5121	1.4927	1.4732	1.4538
1.0	v	283.6	280.2	276.9	273.6	270.2	266.9	263.5	260.2	256.9	253.5	250.2	246.9	243.5	240.2	236.9	233.5
(101.7)	h	950.6	940.2	929.8	919.5	909.1	898.7	888.4	878.0	867.7	857.3	846.9	836.6	826.2	815.8	805.5	795.1
	s	1.7014	1.6829	1.6644	1.6460	1.6275	1.6091	1.5906	1.5722	1.5537	1.5353	1.5168	1.4983	1.4799	1.4614	1.4430	1.4245
1.5	v	194.4	192.1	189.8	187.5	185.2	183.0	180.7	178.4	176.1	173.8	171.5	169.2	167.0	164.7	162.4	160.1
(115.7)	h	957.6	947.3	937.0	926.7	916.4	906.1	895.9	885.6	875.3	865.0	854.7	844.4	834.2	823.9	813.6	803.3
	s	1.6761	1.6582	1.6404	1.6225	1.6046	1.5867	1.5689	1.5510	1.5331	1.5152	1.4974	1.4795	1.4616	1.4438	1.4259	1.4080
2.0	v	147.7	145.9	144.2	142.5	140.7	139.0	137.2	135.5	133.8	132.0	130.3	128.6	126.8	125.1	123.3	121.6
(126.1)	h	962.9	952.6	942.4	932.2	922.0	911.8	901.5	891.3	881.1	870.9	860.7	850.4	840.2	830.0	819.8	809.5
	s	1.6582	1.6408	1.6233	1.6059	1.5884	1.5710	1.5535	1.5361	1.5186	1.5012	1.4837	1.4663	1.4488	1.4314	1.4139	1.3965
2.5	v	119.9	118.5	117.1	115.7	114.3	112.9	111.5	110.0	108.6	107.2	105.8	104.4	103.0	101.6	100.2	98.76
(134.4)	h	967.1	956.9	946.7	936.6	926.4	916.2	906.0	895.9	885.7	875.5	865.4	855.2	845.0	834.8	824.7	814.5
	s	1.6445	1.6274	1.6103	1.5932	1.5760	1.5589	1.5418	1.5247	1.5075	1.4904	1.4733	1.4562	1.4391	1.4219	1.4048	1.3877
3.0	v	100.9	99.71	98.53	97.34	96.16	94.97	93.78	92.59	91.41	90.22	89.03	87.85	86.66	85.47	84.28	83.10
(141.5)	h	970.6	960.5	950.4	940.2	930.1	920.0	909.8	899.7	889.6	879.4	869.3	859.2	849.0	838.9	828.8	818.6
	s	1.6335	1.6166	1.5998	1.5829	1.5661	1.5492	1.5323	1.5155	1.4986	1.4818	1.4649	1.4481	1.4312	1.4144	1.3975	1.3807
3.5	v	87.31	86.28	85.26	84.23	83.20	82.18	81.15	80.12	79.09	78.07	77.04	76.01	74.99	73.96	72.93	71.90
(147.6)	h	973.7	963.6	953.5	943.4	933.3	923.2	913.1	903.0	892.9	822.8	872.7	862.6	852.5	842.4	832.3	822.2
	s	1.6241	1.6075	1.5909	1.5742	1.5576	1.5410	1.5243	1.5077	1.4911	1.4745	1.4579	1.4412	1.4246	1.4080	1.3913	1.3747
4.0	v	77.04	76.13	75.22	74.32	73.41	72.50	71.60	70.69	69.79	68.88	67.97	67.07	66.16	65.25	64.35	63.44
(153.0)	h	976.3	966.3	956.2	946.1	936.1	926.0	916.0	905.9	895.8	885.8	875.7	865.6	855.6	845.5	835.4	825.4
	s	1.6161	1.5997	1.5832	1.5668	1.5504	1.5340	1.5175	1.5011	1.4847	1.4683	1.4518	1.4354	1.4190	1.4025	1.3861	1.3697
4.5	v	68.99	68.17	67.36	66.55	65.74	64.93	64.12	63.30	62.49	61.68	60.87	60.06	59.25	58.44	57.62	56.81
(157.8)	h	978.8	968.7	958.7	948.7	938.6	928.6	918.5	908.5	898.5	888.4	878.4	868.4	858.3	848.3	838.3	828.2
	s	1.6090	1.5928	1.5765	1.5603	1.5440	1.5278	1.5115	1.4953	1.4790	1.4628	1.4465	1.4302	1.4140	1.3977	1.3815	1.3652
5.0	v	62.49	61.76	61.02	60.29	59.55	58.82	58.08	57.35	56.61	55.88	55.14	54.40	53.67	52.93	52.20	51.46
(162.2)	h	98.10	970.9	960.9	950.9	940.9	930.9	920.9	910.9	900.9	890.9	880.9	870.8	860.8	850.8	840.8	830.8
	s	1.6027	1.5866	1.5705	1.5544	1.5383	1.5222	1.5061	1.4900	1.4739	1.4578	1.4418	1.4257	1.4096	1.3935	1.3774	1.3613
5.5	v	57.15	56.48	55.81	55.14	54.46	53.79	53.12	52.45	51.77	51.10	50.43	49.76	49.09	48.41	47.74	47.07
(166.3)	h	982.9	972.9	963.0	953.0	943.0	933.0	923.0	913.0	903.0	893.1	883.1	873.1	863.1	853.1	843.1	833.1
	s	1.6289	1.6130	1.5970	1.5811	1.5651	1.5492	1.5332	1.5173	1.5013	1.4854	1.4694	1.4535	1.4375	1.4216	1.4056	1.3897
6.0	v	52.68	52.06	51.44	50.82	50.20	49.58	48.96	48.34	47.72	47.10	46.49	45.87	45.25	44.63	44.01	43.39
(170.1)	h	984.8	974.8	964.8	954.9	944.9	935.0	925.0	915.0	905.1	895.1	885.2	875.2	865.2	855.3	845.3	835.3
	s	1.5919	1.5761	1.5603	1.5444	1.5286	1.5128	1.4970	1.4812	1.4653	1.4495	1.4337	1.4179	1.4021	1.3862	1.3704	1.3546

Thermodynamic Table Of Wet Steam — II

► This is the second table of the 2-part series on wet-steam properties. The first appeared in the February issue on page 109. These tables cover moisture contents ranging from 0 to 30. They are laid out in a fashion similar to the superheat tables in the Keenan & Keyes steam tables. Columns are arranged against percent moisture of saturated mixture.

Symbols are: v = specific volume, cu ft per lb; h = enthalpy, Btu per lb; s = entropy, Btu per F per lb. Proportional interpolation determines intermediate state properties.

B G A Skrotzki, *Associate Editor*

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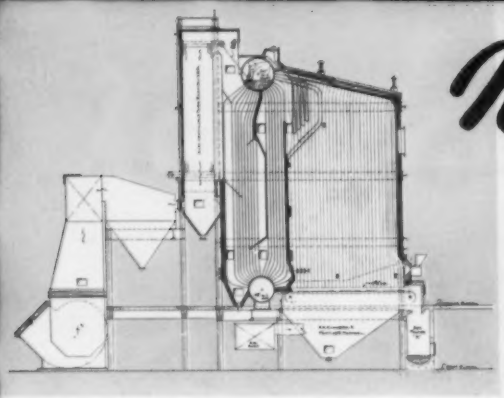


Now Operating

at Utah-Idaho Sugar Company's Big New $7,000,000 Columbia Basin Beet Sugar Factory near Moses Lake, Washington . . .

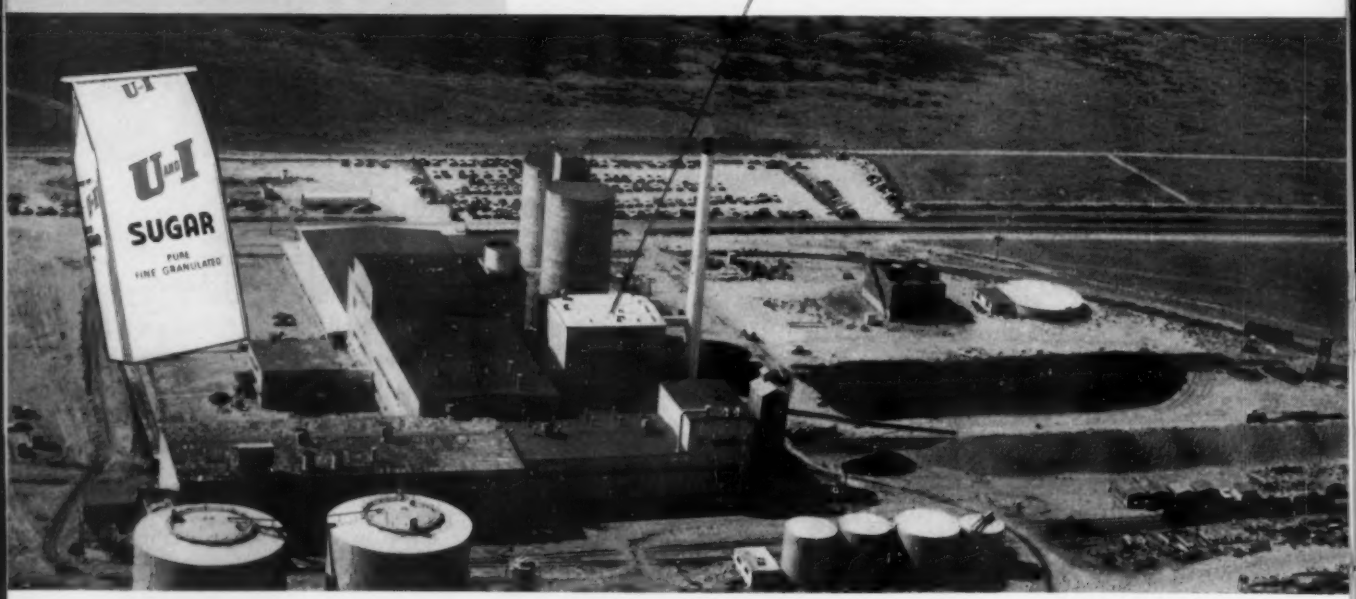
250,000 lbs./hr. RILEY BOILER FIRED BY A RILEY TRAVELING GRATE SPREADER STOKER

BOILER ENGINEERING DATA

Riley Model "RX"
Capacity 250,000 lbs./hr.
Peak Capacity 285,000 lbs./hr.
Design Pressure 475 psig.
Superheater Outlet Temp. 575°F.
Furnace Width 28' – 9¾"
Furnace Depth 17' – 2¾"
Furnace Height 32' – 6"
Furnace Heat Release 26,850 B.T.U.
Grate Heat Release 761,000 B.T.U.
Size of Grate 28' x 19'
Efficiency 83.8%

Rising above the flat plains of the Columbia Basin is this large new sugar producing plant recently started up by Utah-Idaho Sugar Company. In its first year of operation this plant will produce in excess of 75,000,000 pounds of sugar, thousands of tons of molasses and dried beet pulp for livestock feed.

Steam generating equipment must be able to operate continuously and at full capacity during the entire production season. The most reliable equipment available is therefore mandatory. The Riley Erection and Service Departments completed this installation on a very close time schedule. There has been no interruption in steam production since it went on the line.



. . . and some other large Riley Traveling Grate Spreader Stoker Installations . . .

GAYLORD CONTAINER CORP.
Bogalusa, La.—250,000 lbs./hr.
Size of Grate—22' x 20'

KENNECOTT COPPER CORP.
McGill, Nev.—235,000 lbs./hr.
Size of Grate—28' x 18'

CHAMPION PAPER & FIBRE CO.
Canton, N. C.—200,000 lbs./hr.
Size of Grate—24' x 22'

MONTANA-DAKOTA UTILITIES
Mandan, N.D.—250,000 lbs./hr.
Size of Grate—26' x '20'

STOKER ENGINEERING DATA

Eight Riley overthrow feeders with adjustable distributor blades and grates. Dust-tight gear case and dust-tight self-lubricating feeding mechanisms. Front ash discharge.

Twin grates are powered by two drives—one motor powered, the other turbine powered; drives are inter-connected hydraulically and controlled by flow control valve for grate speed regulation.

RILEY FEEDER-DISTRIBUTOR

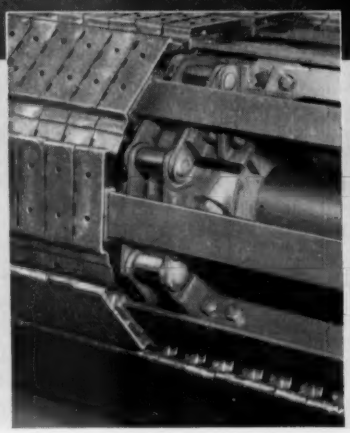
Feed is uniform and positive regardless of coal characteristics and moisture. Coal distribution is adjustable without necessity for shutting down.

RILEY HYDRAULIC DRIVE

The Riley hydraulically driven Grate Drive is completely enclosed and self-lubricated, and has no sprockets, chains and speed reducers. Hydraulic circuit provides positive overload protection. Complete grate speed control from zero to full load is provided. Drive uses little power and needs practically no maintenance.

RILEY GRATE SURFACE

View of the grate shows how special growth-resistant alloy clips overlap and separate to free themselves of ashes and clinkers. Use of small grate clips, two inches wide with a six-inch pitch, minimizes distortion.



TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION

WORCESTER, MASS.

Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle

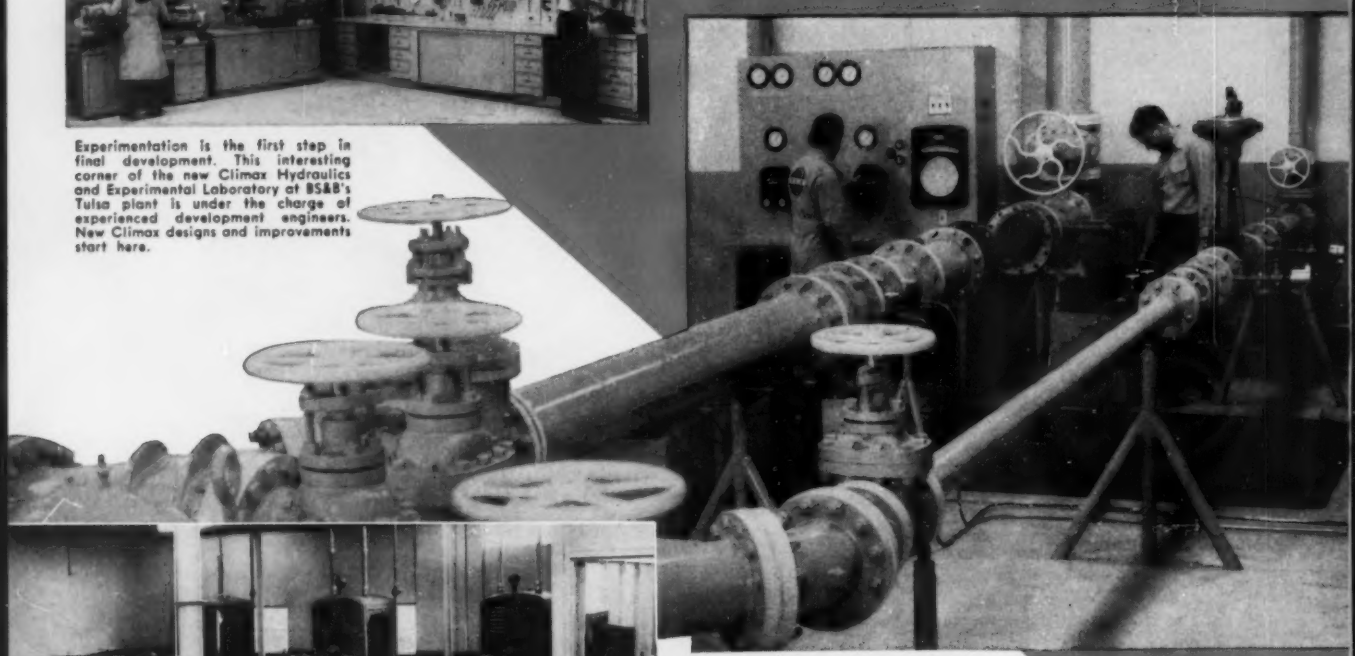
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

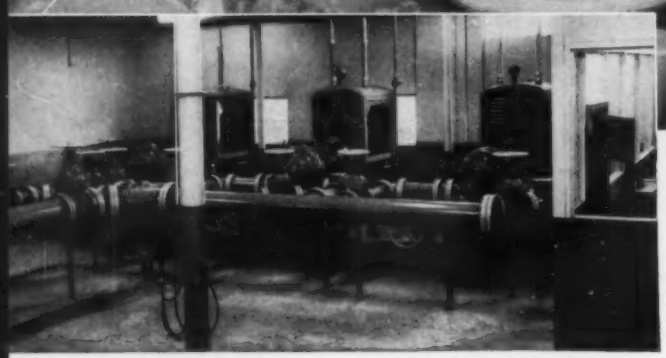
Testing the performance on which BS&B reputation has been built;

Pre-Proving CLIMAX CONTROLS to Insure On-The-Job Efficiency

Experimentation is the first step in final development. This interesting corner of the new Climax Hydraulics and Experimental Laboratory at BS&B's Tulsa plant is under the charge of experienced development engineers. New Climax designs and improvements start here.



The finished control on the "torture rack." Meter runs flow test the valves up through 10". Strain gauge equipment analyzes forces and stress under performance. Control panel in background regulates engines driving the pumps and registers flow data for calculation.



Pump manifolding for the 3 engine-driven pumps which will deliver up to 4500 gallons per minute at a 100 lb. discharge for high volume tests. Pumps can also be manifolded for series operation, in which case 300 lbs. of water at 1500 gallons per minute can be delivered.

There's no question about a Climax Control giving the satisfactory service for which it is designed. That performance is tested and proven before the control goes into the field . . . checked for minimum and maximum capacity. Flow, flow effects, valve characteristics and strain results are all evaluated by experienced engineers. Through the new BS&B Climax Control Hydraulics laboratory come a continuing series of answers to the more efficient, safe and profitable application of automatic controls. One test suggests another, one application is adapted to a similar problem. The net result: Through research, better engineering, and accurate pre-testing, comes a more efficient Climax Control.

New Climax Controls Hydraulic and Experimental Laboratory

BLACK, SIVALLS & BRYSON, INC.

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CLIMAX BS&B CONTROLS OUR 50TH YEAR

a Power practical manual

GASKETS*

By Steve Elonka, *Associate Editor*

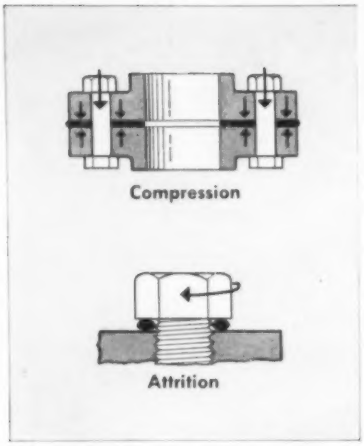
Because gaskets seem simple, their importance is too often overlooked. Yet one leak recently took a large hydraulic press out of service for ten days. Lost production cost $500 an hour—all for a small gasket!

Leaky pipe flanges, stuffing boxes, joints of all kinds cost American industry billions of dollars yearly. And the problem of sealing these joints gets tougher all the time as industry's arteries carry an ever-widening variety of fluids at ever higher pressures and temperatures.

But the same technical savvy that gives new fluids to seal also yields new materials and methods to do the job. Knowing where and when to use them will cure one of the sorest spots in today's skyrocketing maintenance budgets. To help you with this problem, here's a roundup of the latest dope on sealing materials and methods — the time-proven ways as well as a host of new ones.

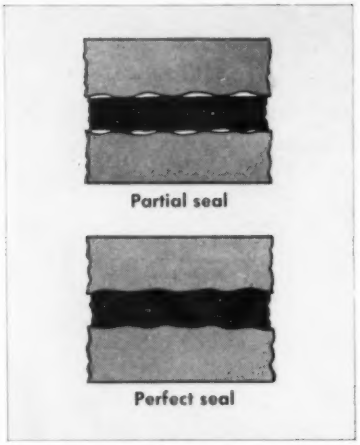
* GASKET is a packing designed for inclusion between rigid parts of a fluid container in essentially stationary relationship. GASKETING (collective) is material in sheet, strip or bulk form, from which gaskets may be prepared. *(Definitions from American Society for Testing Materials)*

NOTE: This is Part 1 of a 3-part handbook on *Seals*. Part 2, *Packing*, and Part 3, *Mechanical Seals*, will appear later.



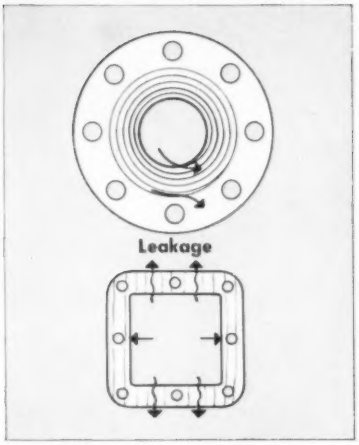
Gasket material must flow

To seal tightly, gasket must conform to joint's mating surfaces. Most gaskets are made relatively soft, so compressing them causes the material to squeeze into surface irregularities. With some materials, heat does the same thing. Another form of "flow" results from combined compression and dragging action, called attrition.



Bolt pressure, surface finish affect sealing action

For any given gasket material, a certain pressure produces just so much flow. That may be enough to fill irregularities of a fairly smooth surface, say an ordinary machined flange, but not those of a rough surface, like a serrated flange (*top sketch*). If joint can take more bolt pressure, tighter squeeze will fill both sides (*bottom*).



If flange serrations are "phonograph" type (continuous spiral) they must be completely filled or there's a path for fluid pressure to escape. With concentric serrations, partial filling of grooves may be enough. Parallel shaper or planer grooves make life tough for gasket—there are paths for pressure escape on two sides of the flange.

Gaskets supply the give that makes a tight

In piping, and all kinds of machinery, we've got the problem of making pressure-tight joints between two rigid elements —flanges, say. We can do it, but only if flanges are machined to mate perfectly, and can be counted on to stay that way. Such a joint is practical only in rare cases, so we turn to gaskets. Because they're designed to give, they make up for imperfections of the average joint—surface roughness, small misalignments, etc.

At relatively small cost, gaskets do away with need for precision machining. And it's easier to replace a gasket than to re-machine surfaces when something goes wrong.

How Gaskets Seal. To stop leakage, flat gasket in a flanged joint must be squeezed between joint faces, tight enough so it exerts more pressure against faces than fluid pressure tending to leak past it. Since most joint surfaces aren't perfectly smooth, gasket material must "flow" into hills and valleys of joint faces to get good mating and a tight seal with no leakage pathways.

Usually, gasket materials are made to flow by compressing them between flanges. In some cases, heat may do the job, as when a bell-and-spigot joint is sealed with molten lead. In other cases, copper ring on screw plugs, for example, flow is caused by combined compression and dragging action—called attrition.

Surface Condition. In ideal contact, gasket material fills every depression in joint surfaces completely. This depends on gasket material and condition of joint surfaces (*sketches above*). Whether partial filling of tool marks, etc, is good enough depends on nature of grooves. Ordinary spiral tool marks (so-called phonograph finish) leave a continuous path for leakage unless filled. But concentric serrations leave no such path and complete filling isn't as important. Really tough problem comes on joints finished with planer or shaper tools—parallel grooves give paths for pressure leakage on two sides.

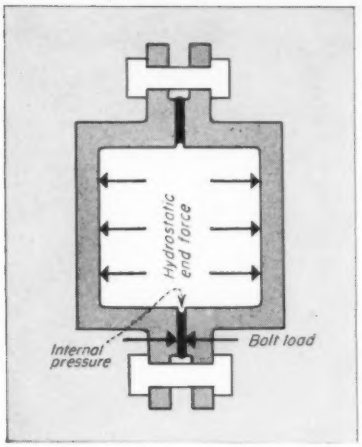
What Finish? Smooth surface is usually best. Serrations —V-grooves 1/32 in. apart—are OK with soft gaskets. Never use phonograph finish with metallic gaskets, or any gasket for high pressures.

If joint surfaces are smooth, problem of leakage can't be solved by merely refinishing with rougher tool marks. If you do that, bolts must be strong enough to stand extra stress needed to flow gasket into deeper grooves.

Forces on Joint. Pressure in pipe tends to push flanges apart. Bolts resist this. In addition, they must be loaded enough to squeeze gasket and keep pressure from leaking past. Since pressure pushing joint apart (*hydrostatic end force*) works against exposed portion of flange faces as well as internal diameter of pipe, always try to use gasket with about same ID as flange. This keeps hydrostatic end force to minimum, reduces needed bolt load.

Seating Force. The force needed to make gasket material flow into surface imperfections is known as *seating force*. It's usually expressed as unit stress in gasket, psi, and is considered independent of internal pressure.

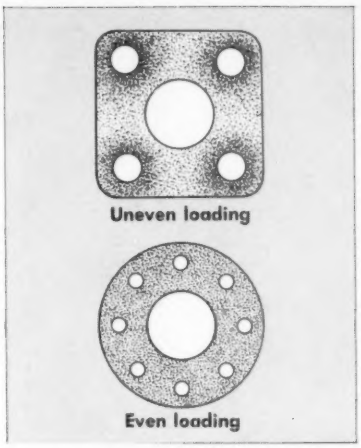
For most gasket materials, it's important to apply a high

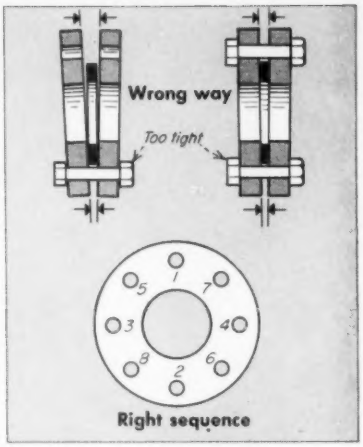


These forces act on joint

In a working joint, with pressure in the pipe, hydrostatic end force tries to push flange faces apart. Bolt load resists this action, and must be enough greater to put sufficient squeeze on gasket to maintain a tight seal against internal pressure.

Carbon print of pressure distribution shows most pressure, and hence most flow, is around bolts (*upper sketch*). Joint of this type will give trouble because sealing effect midway between bolts is poor. Solution lies in better bolting layout, with more uniform pressure distribution.





Bolt layout and tightening make a big difference

If you tighten one bolt full, flanges cock out of parallel. Taking up on another bolt won't bring them back even. Resulting poor pressure distribution encourages leaks, speeds failure. Right way is to take up all bolts hand tight first. Next tighten two bolts diametrically apart, then two as near 90 deg from first two as possible, and so on as indicated in sketch. Tighten bolts again after joint comes up to operating condition.

seal in a rigid joint

stress initially, to get full flow and good seating. Then load on gasket can be reduced without hurting seal. Such reduction of load on gasket usually occurs naturally as a result of bolt expansion and creep, gasket "settling."

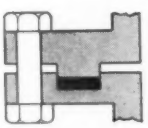
Bolting Layout. Most gaskets are used in bolted joints. Carbon prints, *sketch above*, show pressure is greatest close to bolts, weakest midway between. This puts a premium on good bolting layout—adjusting number and spacing of bolts to distribute total load uniformly around gasket. It also means knowing the operating conditions to be met and the kind of gasket best suited for them. In other words, the gasket should be designed into the joint, not selected by cut-and-try after the joint gives trouble.

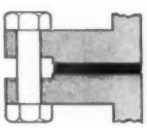
Tightening Bolts. Follow right sequence in bolt tightening (*see sketch above*). Equally important: Don't overstress bolts by whanging away at the end of a long hickey or oversize wrench. Overstressed bolts take a permanent set, won't keep the squeeze on gaskets.

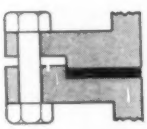
Gaskets at Work. With joint at working conditions, hydrostatic end force tries to separate flanges. Bolts, gasket and flanges expand. Net effect is less contact pressure on gasket. That's why bolts are easy to take up after they've been in service. At high temperatures, don't overlook effect of bolt creep, slow flange deformation. And sudden temperature and pressure changes give joints a real wallop, hence often cause serious leakage problems.

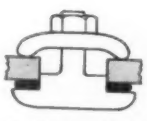
To see how designers build resiliency into gaskets to meet operating conditions, turn to following pages.

Four types of gasketed joints


Confined


Unconfined


Partly confined


Self-energized

Gaskets may be broadly classified by the type of joint they seal:

Confined gaskets have no freedom to flow except for slight clearance between mating faces.

Unconfined gaskets are free to flow away from and toward fluid pressure.

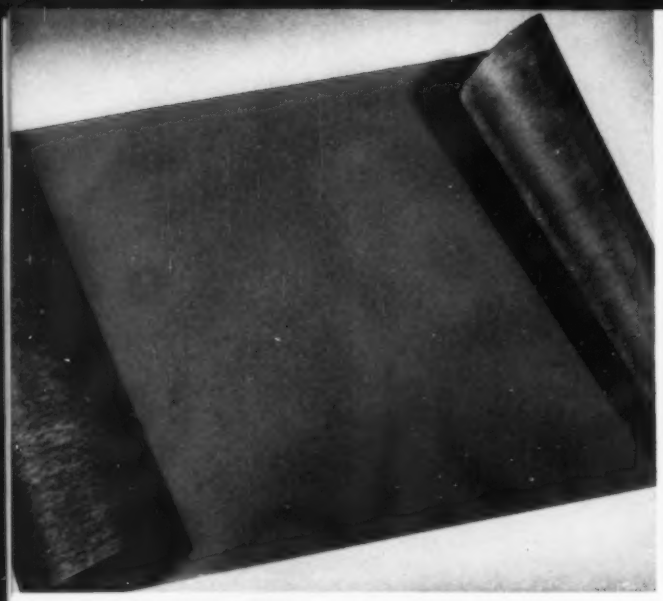
Partly confined gaskets are free to move on either inside or outside rim.

Which Joint? In unconfined joint, gasket can be blown out if it isn't loaded enough. With confined or partly confined joint, worst that can happen is a slow pressure leak.

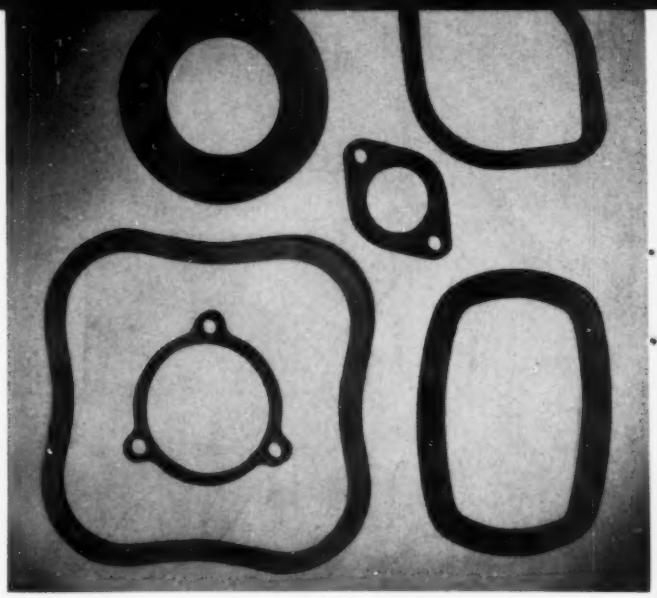
Because unconfined joint is most practical it's commonly used for piping and many other joints. Most metallic gaskets can be considered as self confining. Some gasket makers design semi-metallic gaskets for unconfined joints by putting a retaining ring, or similar device, outside.

Self-energized joints are used mostly on boiler handholes and manholes. These may have only one bolt; don't depend on bolt pressure to keep them tight. Fluid pressure working on entire plate area provides gasket load.

Critical period is while pressure is being brought up—initial bolt pressure drops to zero as fluid pressure climbs. So you have to tighten bolt from time to time until final pressure is reached. In this type of joint, make sure surfaces are even, gasket area is big enough for load.



COMPRESSED SHEETS are white or blue asbestos, compounded with various binders. They come in sheets up to 150 in. square



GASKETS of many shapes and sizes are made of sheet material either by the manufacturer, or by maintenance men in plants

Asbestos, pressed or woven, can be cut in shop

Where heat plays a part, asbestos is probably the most widely used gasketing material. It is pressed, woven, compounded and reinforced to give the service qualities needed. From its several basic forms, gaskets can be cut or shaped as needed. Or you can buy factory-made gaskets in standard or cut-to-order shapes. The following information will help you use this versatile material to best advantage.

White Asbestos. This popular gasketing material is mostly magnesium silicate with about 14% water of crystallization, which makes it a hydrated magnesium silicate. Theory is that, in early geologic ages, asbestos was deposited in cracks of rock, while under great pressure and temperature. Thus elongated crystals formed at right angles to crack. Width of crack determined fiber length.

Natural asbestos fibers aren't well suited for forming strong sheets or cloth, so must be reinforced. Cotton is often used for low-temperature work; it gives the quality of softness. For higher temperatures, fine brass wire is a common reinforcing agent.

Up to 900 F (where steel turns dull red) asbestos fibers are relatively unaffected. Above this range, water of crystallization is gradually driven out, strength is lost rapidly. At 1300 F, it's just about gone. With little or no water of crystallization, asbestos is reduced to a powder when rubbed between the fingers.

Acid Resistance. White asbestos can be used with weak acids and most alkali solutions. But asbestos alone has little resistance to action of strong mineral acids. Impregnated with rubber or a plastic, corrosion resistance of gasket depends largely on resistance of the impregnant.

Blue Asbestos. This material, known technically as crocidolite, is used in compressed-sheet and woven-cloth form. For low pressures and temperatures, it's acid resistant but costs much more than white asbestos. Temperature limits are about the same. Since it's either about equal or inferior to white asbestos in most respects, and is more expensive, its practical use lies where acid resistance is important.

Compressed Sheets. Asbestos for gasketing is made into compressed sheets or woven cloth. Best grades of sheet gasketing are made of long-fiber asbestos. Fibers, compounded with one of a variety of binding agents, are vulcanized into a homogeneous structure, under great pressure.

Sheet is usually 65 to 75% fiber; remainder is binder or compounding agent. Natural rubber, neoprene, buna-S and other synthetic binders are used, compounded in the usual manner with plasticizers, anti-oxidants, etc. Where sulfur may set up corrosion, neoprene may be the answer as it does not contain sulfur. Consult your gasket manufacturer.

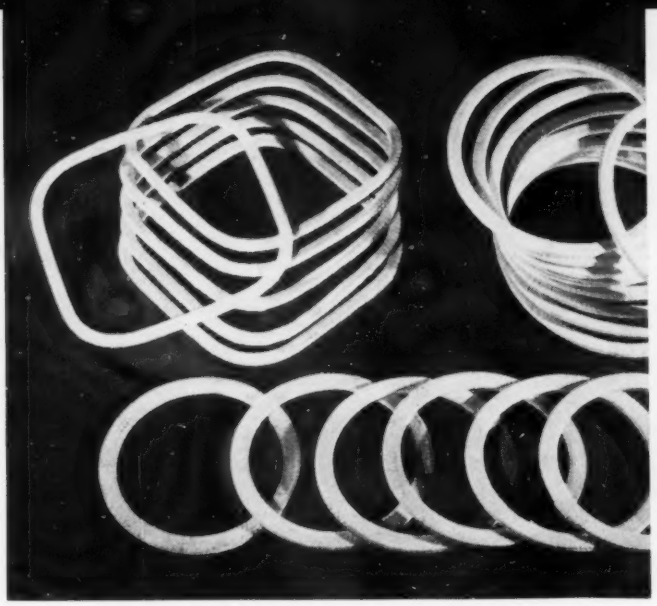
Asbestos sheets are strongly resistant to plastic flow under heavy bolt load. But good-quality material is compressible enough to compensate for slight unevenness or irregularities in surfaces of most flanged joints. Sheets are made very dense, or softer, according to service.

Applications. Depending on compounding agent, asbestos sheets are used for superheated and saturated steam, air, gas, alkaline solutions, weak acids, ammonia, brine, oil, chemical solutions and petroleum distillates.

Sheets from 1/64 to $\frac{1}{8}$ in. are usually one-piece; those above $\frac{1}{8}$ in. are laminated. While many firms offer sheet gaskets for sale, they don't all make the sheets. Avoid headaches by ordering gaskets for your specific service conditions.

Coating. Some users want one side of asbestos sheets graphited so gasket is not spoiled when breaking joint. Others want both sides graphited. For some services, graphite or soapstone on gaskets might discolor any liquid coming in contact with the gasket.

Soaking Gaskets. Old-time maintenance men often soak asbestos gaskets in hot water so they swell. Then gaskets seat better by filling irregularities in joint. Gasket makers say this is OK—if water is very hot. Usually, you don't have to do this if the right material is used for the job.



FOLDED ASBESTOS CLOTH reinforced with fine brass wire is made into gaskets shaped for handhole and manhole plates

HOMEMADE folded-cloth gaskets are produced in an emergency by inserting lead into end of round stock and taping joint

from sheets, or can be bought in gasket shapes

Beware of asbestos gaskets sold at a "price." Short fiber is much cheaper but very inferior to long, and gasket may disintegrate. Binder of reclaimed rubber needs more sulfur for vulcanizing, makes poor gasket for some jobs. Leading firms use only best ingredients—often can't compete when bidding for job on price alone.

Woven Cloth. Because this material is much softer and more pliable than compressed sheets, it solves many tough gasketing problems. Use for pitted or warped joints that compressed-sheet gasket won't seal.

Cloth is woven of long-fiber asbestos-yarn, reinforced with fine brass wire. Cotton is also used for reinforcing, or to make material more pliable for very low temperatures. Because woven asbestos is porous, these gaskets are impregnated with either rubber or plastic compounds. Here again, impregnation is limiting factor for temperatures. If organic filler is used, the filler's characteristics change when reaching 200 to 400 F.

Quality. Cheaper grades of cloth are woven of poorer-quality short asbestos fibers, combined with cotton to hold it together. Look out for shrinkage in this material. Heat resistance, which is low, is limited by cotton content.

Woven cloth runs from 1/32 to 1/16 in. thick. Above that, sheets are folded over into two or more plies to obtain the thickness needed.

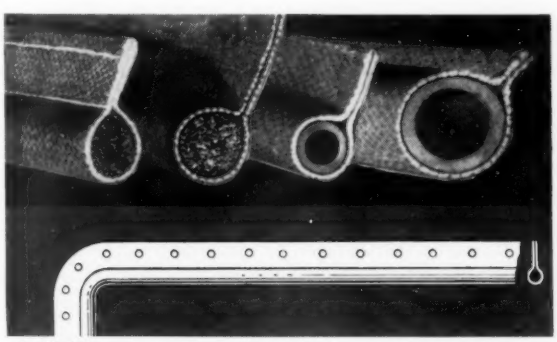
Folded Cloth. Common asbestos-cloth gaskets for small handholes and larger manhole plates may be round, oval, square or special shapes (*photo above*).

Cloth is treated with a heat-resistant rubber cement, folded, formed and pressed to size and shape. These gaskets are also good for warped or uneven joints—to seal steam or gases up to 600 F.

Blue asbestos cloth, treated with neoprene cement, comes in round and flat sections as well as sheets. It serves against strong mineral acids, oils, organic solvents.

Tape comes in rolls of various widths and thicknesses up to 100 ft in length. It's also formed in round sections with diameters of ¼ to 1 in. These are handy for making gaskets of any size (*photo, top*).

Above $\frac{3}{8}$-in. diameter, the centers are hollow. Lead connectors are furnished to stick into hollow ends for jointing. Thin friction tape holds ends together while the gasket is being formed to size and shape desired.



TADPOLE tapes make a tight seal with very low bolt loading

Tadpole Tape. This is made of asbestos cloth wrapped over a core of asbestos wick, rope, rubber tubing, etc, depending on size, softness required, service conditions (*photo immediately above*). Extending cloth on one side forms a flange for fastening to door frame by riveting, gluing, or some other means. This leaves "bulb" or round side of tape free to form a cushion for sealing where a tight joint is needed with minimum pressure.

Tadpole firewall seals are made with cores of Inconel mesh or with synthetic rubber for hot places. Tests show they resist penetration of 2000-F flame and continuous temperatures up to 500 F for very severe service.

Here's how natural and

Chart at right is for general information only, because chemical effects are too complex to sum up fully in a few words. While chemical properties are apt to be in forefront of thinking when rubber gaskets are considered, don't forget the mechanical features. They may often be more important. Remember, too, that gaskets are not usually fully exposed to the fluid they seal, a factor which may further swing emphasis from chemical to mechanical properties.

Remember that chart information is highly condensed, hence is general and there are exceptions. For example, under "water resistance" for neoprene we list "poor." This is only generally true, as neoprene can be compounded for good water resistance.

Give gasket maker full information when you use rubber types. These materials do an excellent job but the manufacturer can help solve your sealing problem only when he knows what you need. Here are some important points to cover:

1. Operating pressure, maximum and normal. Also relative time periods each is applied. This helps decide gasket type, hardness, tensile strength, etc.
2. Give same data for temperatures, to aid in selecting base polymers and compounding.
3. Specify fluid gasket will contact. Give brand names and grades, not just "hydraulic fluid" or "medium lubricating oil." For example, different refineries vary aniline points widely for same over-all oil specifications. Aniline point affects volume change of various types of rubber, so it's important. Oil additives may also affect rubber and should be known.
4. Tell what metals contact the gasket and the surface finish in microinches, if possible. Also state if turned, ground, superfinished, etc. (This info is more valuable for packing than gaskets.)
5. Describe design and dimensions of sealing area.

General classification	Natural rubber	Buna S
Specific gravity	0.93	0.94
Tensile: Pure gum	3000	400
Reinforced	4500	3000
Tear resistance	Excellent	Poor-fair
Abrasion resistance	Excellent	Good
Aging:		
Sunlight	Poor	Poor
Oxidation	Good	Fair
Heat, max temp, F	300	250
Static (in storage)	Good	Good
Flex cracking resistance:		
Slow rate	Excellent	Good
Fast rate	Excellent	Poor
Compression set resistance	Good	Good
Solvent resistance:		
Aliphatic hydrocarbon	Very poor	Very poor
Aromatic hydrocarbon	Very poor	Very poor
Oxygenated solvent	Good	Good
Halogenated solvent	Very poor	Very poor
Oil resistance:		
Low aniline	Very poor	Very poor
High aniline	Very poor	Very poor
Gasoline resistance:		
Aromatic	Very poor	Very poor
Nonaromatic	Very poor	Very poor
Acid resistance:		
Dilute (under 10%)	Good	Good
Concentrated (except nitric and sulfuric)	Fair	Poor
Low temperature resistance, max, F	-65	-70
Permeability to gases	Fair	Fair
Water resistance	Good	Very good
Alkali resistance:		
Dilute (under 10%)	Good	Good
Concentrated	Fair	Fair
Resilience	Very good	Fair
Elongation, max, %	700	500

Rubber in a variety of forms, both natural and

An ideal gasket material in many ways, rubber is elastic and squeezes into joint imperfections under comparatively light bolt loading.

Natural rubber is used mostly for hot or cold water, sometimes for low-pressure steam or gas. Synthetic rubbers stand up under higher temperatures and some of them can be used for sealing against oil. But before going into types and applications, let's take a look at the elements of rubber chemistry.

Rubber Chemistry. To understand rubber, let's start with the water molecule, which is H_2O. This is really H-O-H, because oxygen atom is in the middle and hydrogen atoms revolve around it like two earths moving around opposite sides of our sun. Hydrogen atoms are held in their orbits around the oxygen atom by *valence bonds*. These act like links or hooks. Oxygen atom has two such links, hydrogen atoms one each. So we say oxygen has a valence of two and hydrogen a valence of one.

A vast range of substances are composed of hydrogen and carbon atoms. These *hydrocarbons* differ in number and arrangement of atoms. An important characteristic of carbon atoms is their ability to link readily with each other, to form straight chains, rings or combinations of chains and rings.

Polymers. Two or more molecules of an original substance—sometimes hundreds or even thousands—may join together end to end, like boxcars in a long train, to form a giant molecule. This is a *polymer*, and the process of joining is called *polymerization*. The simplest repeating structural unit of a polymer is a *monomer*.

When molecules of two or more substances join to form a giant molecule, we have a *copolymer*. If a polymer is like a train of boxcars, a copolymer may be likened to a mixed freight of tank cars, boxcars, flats, etc. Natural rubber and most synthetics are polymers or copolymers.

Natural rubber is a polymer of a

synthetic rubbers stack up against various service conditions

Buna N		Neoprene		Butyl	Thiokol		Silicone
Low swell Hycar and butaprene	High swell Paracril and chemigum	Type GN	Type W	non–oil resistant	Type PR - 1	Type ST	rubbers
1.00	1.00	1.25	1.25	0.91	1.35	1.35	1.2 To 2.6
600 4000	600 4000	3500 3500	3500 3500	3000 3000	300 1500	300 1500	200 – 450 - - -
Fair	Fair	Good	Good	Good	Fair	Fair	Poor-fair
Good	Good	Excellent	Excellent	Fair	Poor	Poor	Poor
Poor Fair 300 Good	Poor Fair 300 Good	Excellent Good 300 Very good	Excellent Good 300 Very good	Excellent Good 300 Good	Good Good 160 Fair	Good Good 160 Fair	Good Very good 450 Good
Good Poor Very good	Good Poor Very good	Excellent Excellent Poor	Excellent Excellent Excellent	Excellent Excellent Fair	Fair Poor Poor	Fair Poor Poor	Fair Poor Good
Excellent Good Poor Very poor	Good Fair Poor Very poor	Fair Poor Fair Very poor	Fair Poor Fair Very poor	Poor Very poor Good Poor	Excellent Good Fair Poor	Excellent Good Fair Poor	Poor Very poor Poor Very poor
Excellent Fair	Fair Excellent	Fair Good	Fair Good	Very poor Very poor	Excellent Excellent	Excellent Excellent	Poor Good
Poor Fair	Good Excellent	Poor Good	Poor Good	Very poor Very poor	Excellent Excellent	Excellent Excellent	Poor Good
Good Poor	Good Poor	Fair Fair	Fair Fair	Good Fair	Poor Very poor	Poor Very poor	Fair Poor
-65	-65	-50	-65	-65	-40	-65	-120
Fair Very good	Fair Very good	Very good Poor	Very good Fair	Very good Very good	Good Fair	Good Fair	Fair Fair
Good Fair Fair 500	Good Fair Fair 500	Good Good Very good 500	Good Good Very good 500	Very good Very good Very poor 700	Poor Poor Poor 400	Poor Poor Poor 400	Fair Poor Good 300

synthetic, is an important gasketing material...

hydrocarbon substance called isoprene. It has five atoms of carbon and eight of hydrogen. First commercially successful synthetic rubber, developed by Du Pont and named neoprene, is a polymer of chloroprene. Most synthetic rubbers, however, are copolymers of two or more materials combined to give desired characteristics. The polymerization process tends to increase viscosity, reduces tendency of flow.

Processing Rubber. Crude rubber is believed to contain long straight polymers. When the crude is *plasticized* by milling, these long polymers are broken down and the material becomes soft and easy to process. Then desired characteristics—elasticity, durability, resistance to rupture and abrasion, rigidity and mechanical stability—are restored by vulcanizing. This treatment with sulfur and agents called accelerators is thought to crosslink the long straight polymers with sulfur atoms at frequent intervals. Unvulcanized rubber becomes soft and pliable when heated. After vulcanizing, rubber can be heated until it scorches or burns, but it won't soften. This is important in gaskets.

Some synthetics are plasticized by milling, like natural rubber, and vulcanized with sulfur and accelerators. Other synthetics can be plasticized only with chemical solvents and cannot be vulcanized with usual sulfur compounds.

Durometer Number. Hardness of rubber is measured by *durometer* and the result expressed as durometer, or duro, number. For gasket rubbers, scale runs from 35 to 95. Gum rubber would be 25, too soft for gasketing.

What does the duro number mean to you? Use softer materials (lower duro numbers) with light bolt loads or between flanges in poor condition. Use higher duro numbers for heavier bolt loadings, more-even joint surfaces.

Sheet Rubber. Common colors for natural-rubber gasketing are red and black, but white and brown are also used. Color may indicate service for

Synthetics extend rubber's useful range

which gasket is intended, but it may be more for looks and may not indicate composition. Gasket rubber comes in sheet form, from 1/32 to ¼ in. thick.

Sheet material is also made of reclaimed rubber. For some services this may be as good as virgin rubber, and much lower in price. Because composition of old rubbers going to reclaim aren't known, reclaimed rubber usually can't be controlled closely. Reclaim rubber is often compounded with new to make it more elastic.

Familiar red-rubber gasketing is a tough, resilient sheet up to 80 durometer hardness. Common use is gasketing against cold or hot water, various water solutions (but not strong acids) and also for low-pressure steam and gas. Red rubber is good for moist-type joints up to 300 F.

Soft Sheets. Containing a high percentage of crude rubber, this rubber sheet is very soft, with a durometer hardness of only 35. It's excellent for flanges with very light bolt loads or where surfaces are very irregular. These soft sheets are usually brown.

Wire-Inserted. Because rubber is such a useful gasketing material, it's reinforced with woven wire or cloth to withstand greater pressures and tougher conditions. Services for this type are much the same as for plain rubbers, except this material stands up under vibration or where bolt loads are heavy. Reinforcing keeps rubber from being squeezed out of joint.

Duck-Inserted. Another way to reinforce rubber is with cotton duck. Usually a strong cotton duck in single-ply is used for each 1/16-in. thickness of rubber sheet. This strengthens gasketing just as fabric strengthens a rubber tire. Result is a superior rubber sheet for heavy hydraulic service that would cause unreinforced rubber to creep or blow out. Use on moist-type heavy hydraulic joints to 300 F.

Buna S (GR-S). Letters here stand for government rubber, styrene type. This is a copolymer of butadiene and styrene. "Bu" is first syllable of butadiene, while "na" comes from natrium, classical name of sodium originally used as a catalyst in polymerization of butadiene. Above 23 F, butadiene is a gas.

Buna S is vulcanized with sulfur and rubber accelerators. It can be cured to hard rubber. Carbon black is added to bring out best physical properties. This material is more water resistant than natural rubber, and also shows better resistance to aging (combining with oxygen). But it deteriorates in sunlight.

Heat resistance of buna S is good, but only if there is no severe flexing. It has slightly lower tensile strength and tear resistance than natural rubber, and repeated flexure develops greater heat.

Cold Rubber. This recent development is buna S copolymerized at low temperature. It's superior to natural rubber in abrasion resistance. But ability to withstand gasoline, oil, concentrated acids and solvents (except oxygenated types) is very poor. It shows good resistance to dilute concentrations of acids, alkalis.

Buna N. Synthetic rubbers of the buna-N type are copolymers of butadiene acrylonitrile. The "N" refers to the nitrile or cyanide radical. Typical trade names are *Paracril, Hycar, Chemigum, Butaprene.*

Buna-N types are similar to natural rubber in that they are vulcanized with sulfur and rubber accelerators and may be cured to hard rubber. They may be compounded with natural rubber or with vinyl plastics. Resistance to gasoline "swell" comes from increasing nitrile content, but that decreases cold resistance. Usually buna-N types are compounded for abrasion resistance, high tensile strength, good heat resistance

...even high temperatures, oil and hard-to-seal

Silicone rubber is a semiorganic material, made from elements found in sand, combined with radicals taken from coal and oil. It's based on an inorganic skeleton of alternate silicone and oxygen atoms, with bonds 1.5 times as strong as carbon-to-carbon structure in organic rubbers. To each silicone atom are bonded heat-stable organic groups, giving what chemists call a "satisfied elastomer."

The silicones have excellent heat stability—good low-temperature flexibility. They show high dielectric properties, fine oxidation and outdoor weathering resistance. Good against oils with high aniline points, they're not too good for low-aniline-point oils and most gasolines. They swell when exposed to hydrocarbon solvents and deteriorate markedly when exposed to steam under pressure.

Newest types of silicones display greatly improved mechanical strength. Resistance to permanent compression-set is tripled in one group of stocks, another has four-times better abrasion resistance. Silicone rubbers are useful wherever high or low operating temperatures might cut down life of organic rubbers now in use.

FLEXIBLE and soft after 90-day accelerated aging at 300 F—that's the story on silicone rubber. Compare with high-grade synthetic, a cracked and brittle plastic after one day at same temperature. Bottom photo shows typical silicone tubular shapes

and good compression set. Buna N shows good nonadhesion properties in contact with metals.

Resistance against petroleum, gasoline and aliphatic hydrocarbons is a big buna-N asset. Use buna N for resistance to high and low temperatures aging or abrasion. Buna N is soluble in aromatics, such as toluol, benzol, naphthalene and chlorinated solvents like trichloroethylene. Do not use against amines, ketones, esters, ethers and some organic acids. Buna N has poor resistance to light.

Neoprene. This chloroprene polymer differs from natural rubber in that it is not vulcanized with sulfur. This is an advantage for gaskets contacting flange materials subject to sulfur corrosion. In mechanical properties, neoprene is more like natural rubber than other synthetics.

Tensile strength is higher than other synthetics, almost equal to natural rubber. Neoprene's abrasion resistance is excellent; about equal to natural. Tear resistance is not as good as natural rubber, but neoprene displays excellent dynamic properties and retains these at higher temperatures. Neoprene is also excellent against heat, weathering, sunlight.

In oil resistance, neoprene rates excellent. It's good against nonaromatic gasolines, but poor against aromatics; good against many of the vegetable oils, but mineral oils of low aniline point cause swelling. Even when swelled, it keeps many original properties.

Any neoprene can generally be used against oils with aniline point over 225.

Solvent resistance ranges from very poor to fair, depending on basic solvent involved. If neoprene is held directly over a flame, it burns, but burning stops when flame is removed.

Butyl. This is a copolymer of isobutylene and small amounts of other diolefines, such as isoprene or butadiene. Butyl is often referred to as GR-I, meaning government rubber, isobutylene type. It's economical to produce: Isobutylene, a gas at ordinary pressures, and temperatures above −6 C, is produced in quantity as a byproduct of petroleum cracking. By varying kinds and amounts of diolefines added to make butyl, specific properties can be built in without sacrificing basic characteristics.

Butyl is excellent for resisting gas diffusion. Its chemical stability and resistance to deterioration rate high, but it shows lower physical properties than natural rubber.

Use butyl where resistance to chemicals and oxidation are more important than tensile strength or cold-flow resistance. Butyl resists action of many vegetable or animal fats and oils, but swells like natural rubber in petroleum or coal-tar solvents. It has a low water-absorption rate, good heat and low-temperature resistance. While butyl has good resilience at high temperatures, resilience is poor at room temperature.

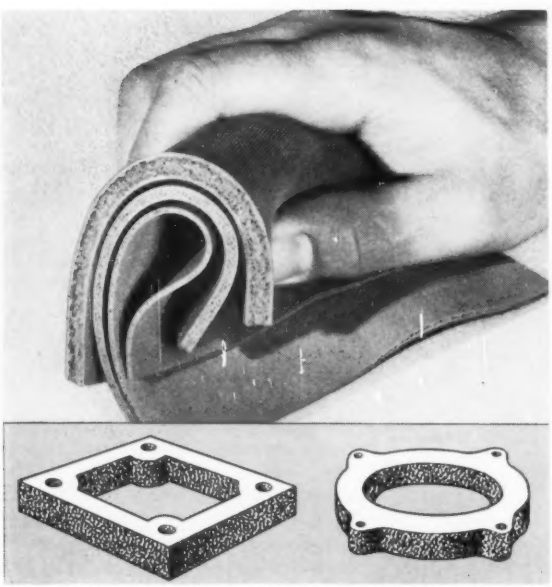
Thiokol. Also known as polysulfide rubber, this comes in various grades: A, B, F, PR-1, ST, etc. Best gasket and sealing types are PR-1 and ST. In processing, thiokols differ from natural rubber. They are milled with plasticizers, not vulcanized with sulfur but usually cured with zinc oxide. They cannot be cured to hard rubber.

PR-1 and ST show best over-all solvent resistance of commercial rubbers, although poor against halogenated solvents. They are not seriously affected by petroleum, hydrocarbons, esters, ethers, ketones, alcohols, gasoline, aromatic blended fuels, water.

Thiokols of PR-1 and ST types have good flexibility at low temperature. Their properties remain stable in cold, but tend to fall off at higher temperatures. Aging behavior is also good.

Thiokols run low in such physical properties as compression set, tensile strength, elasticity, tear and abrasion resistance. Use where minimum swell, freedom from shrinkage and good aging characteristics in contact with active solvents and reagents are needed, and where physical properties are of secondary importance.

surfaces can't stop some of newer rubber types



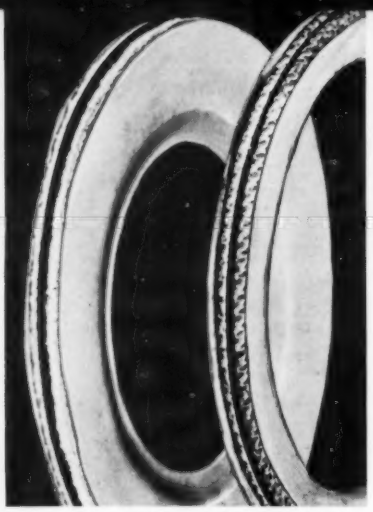
Cellular rubber is chemically blown rubber, photo. It's flexible, elastic, compressible, light, and has low thermal conductivity. It insulates against shock, sound, vibration, air, heat and moisture. Sponge rubber is made from crude or synthetic rubbers, compounded to resist oils, acids, or corrosive vapors at high temperatures. Silicone rubber is also nitrogen-expanded to yield a material having a unicellular structure.

Sponge-rubber sheets come in various densities and compression ranges, with a natural skin on one or both sides (*photo*). Paper, fabric or other pliable materials are also bonded to sides if needed. Above ¼-in. thickness, sheets are glued together to give any thickness needed. Strips come in tadpole, round, square and other shapes.

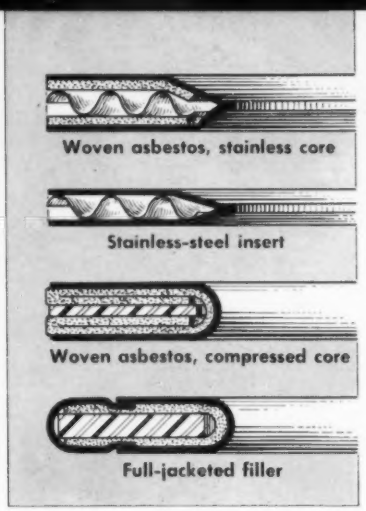
Use for low-pressure gaskets on openings of ductwork, tanks, etc, where uneven surfaces make sealing difficult. A common use is on air-conditioning units, for both gasketing and noise abatement. Use neoprene sponge if sealing against oil; use silicone rubber against high temperatures. Makers compound sponge rubber for specific uses.

UNIFORM cell structure and compression, plus tensile and softness characteristics comparable to regular organic rubbers, makes this silicone sponge suitable for many applications. Typical shapes cut from sponge rubber appear in the sketches, left

Rubber jacketed with Kel-F



Asbestos jacketed with Teflon



Various fillers in Teflon jackets

Tough new plastics are used in combination with familiar materials

Fluoroethylene polymers known as Teflon are fairly new. But already they're threatening to steal the show where high temperatures or corrosive action of strong chemicals quickly destroy natural or synthetic rubbers. Teflon is E I Du Pont de Nemours trademark for this plastic.

Another lusty youngster with a bright future in gasketing is Kel-F. Chemically, it's a polymer of trifluorochloroethylene. Mechanically, it's a very stable high-temperature thermoplastic. Four-fifths of its weight is in two halogens: fluorine and chlorine. In its natural state it's transparent, but may be blended with solid fillers and coloring. Kel-F is the trademark of M W Kellogg Co.

The phenolic resins—familiar for some time under such trade names as Micarta, Synthane, etc—also belong. They're

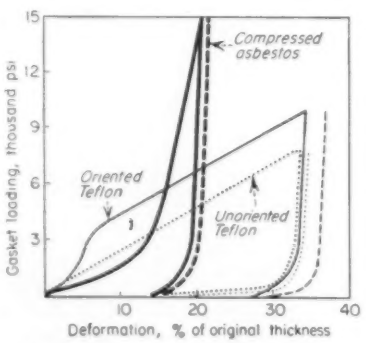
Plastics now step into the gasket spotlight to

In what someone has called the new age of plastics, it's only natural to find these versatile materials taking on a growing variety of jobs in the gasket field. Many possible applications remain to be explored, but enough is known about most of the plastics to get a general idea of what they'll do and where we can use them. Let's take a look at some of them:

Teflon is gaseous tetrofluoroethylene polymerized to yield a granular solid that can be compression molded. Fluorine atoms in the molecules create resistance to heat and chemical attack. Teflon gaskets are formed by machining from molded sheets, extruded rods or tubes, much as metal gaskets are made.

Teflon shows superior chemical inertness from very low temperatures (below zero) to 500 F and above. Only common commercial chemicals and solvents attacking it are molten alkali metals, and fluorine at high temperatures and pressures. Chlorides, boron trifluoride, high-boiling-point solvents, ketones, esters, boiling nitric acid, aqua regia and sodium hydroxide are all resisted by Teflon. Its water absorption is zero and it isn't affected by outdoor weathering.

High mechanical strength holds over the range from –300 F to 500 F, but below –300 F, Teflon becomes very brittle. From about 480 F up it starts losing most of its tensile strength and other physical properties. Electrical properties at high frequencies and high temperatures are excellent. Teflon shows superior resistance to surface arc-over because it melts and vaporizes instead of carbonizing to leave a conducting path. Its power factor, low dielectric constant and high dielectric strength remain unaffected up to 400 F and over.



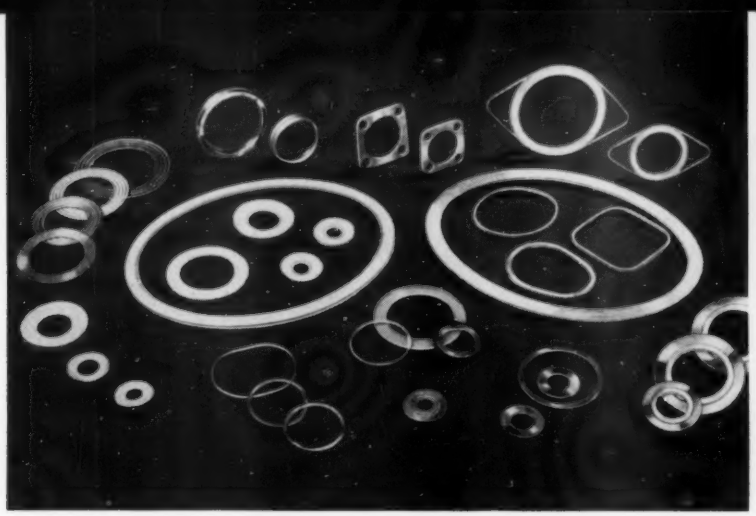
Gasket material compression curves

Ultraviolet rays do not affect Teflon.

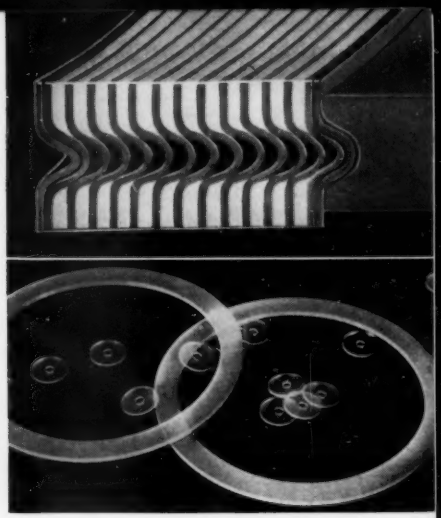
Nothing sticks to Teflon. For gaskets or seals, this natural slipperiness reduces friction where oil can't be used. Never employ Teflon at temperatures over 650 F as it decomposes and gives off poisonous fumes. As with most plastics, cold flow increases rapidly at high temperatures.

Jacketed Gaskets. Because of its chemical inertness, Teflon is popular in envelope-type and molded-shield gaskets. Inserts may be woven or compressed asbestos, corrugated stainless steel, neoprene or other materials that give needed elasticity. Typical "sandwich" constructions appear above.

Mechanical properties of solid Teflon are similar to those of best-grade rubber-bonded compressed asbestos. This makes gasket design for the two materials about the same. But compression characteristics differ (chart). Under compression, Teflon behaves like a conventional solid mass. But asbestos compresses at a decreasing rate with increasing load. When load is relieved, the two materials recover at about the same rate. Dotted lines in chart show recovery after same load is reapplied. Steepness of these curves show a similar lack



Many shapes and sizes of gaskets using plastics



Teflon in spiral-wind; solid Kel-F

or by themselves to form a wide variety of gasket types and shapes

formed from layers of fibrous sheet filler, impregnated with a thermosetting resin binder, bonded under high heat and pressure into a strong, solid material.

Polyethylene is another of the new plastics, expected to have growing usefulness in several fields. On the critical list now, it will probably be in more ample supply late in 1954. Exceptional electrical and chemical-resistance properties make it a promising gasket and packing material. But thermal stability is relatively low, which limits its use for some applications.

Polyethylene is exceptionally resistant to highly oxidizing acids, such as fuming sulfuric and nitric acids. But its resistance to solvents is only fair. Because polyethylene can be injection molded it's suitable for volume production.

seal many chemicals, resist high temperature

of resiliency in both materials. This presents a problem where temperature changes alter pressure on gasket. Spring-loaded bolts sometimes help in solving this problem.

Kel-F shows high resistance to electricity and a very low heat conductivity, making it a good electrical insulator. It also boasts high impact strength at low temperatures, excellent resistance to thermal shock.

Unplasticized Kel-F is nonflammable and highly resistant to chemical attack. No effects appear after long exposure to solvents, concentrated mineral acids, alkalis, fuming nitric acid, aqua regia, hydrogen fluoride and peroxide, and other vigorous oxidizing and reducing agents. It is not wet by water, has zero moisture absorption and excellent outdoor weathering qualities. Plasticized Kel-F shrinks in some hydrocarbons, solvents and hot water.

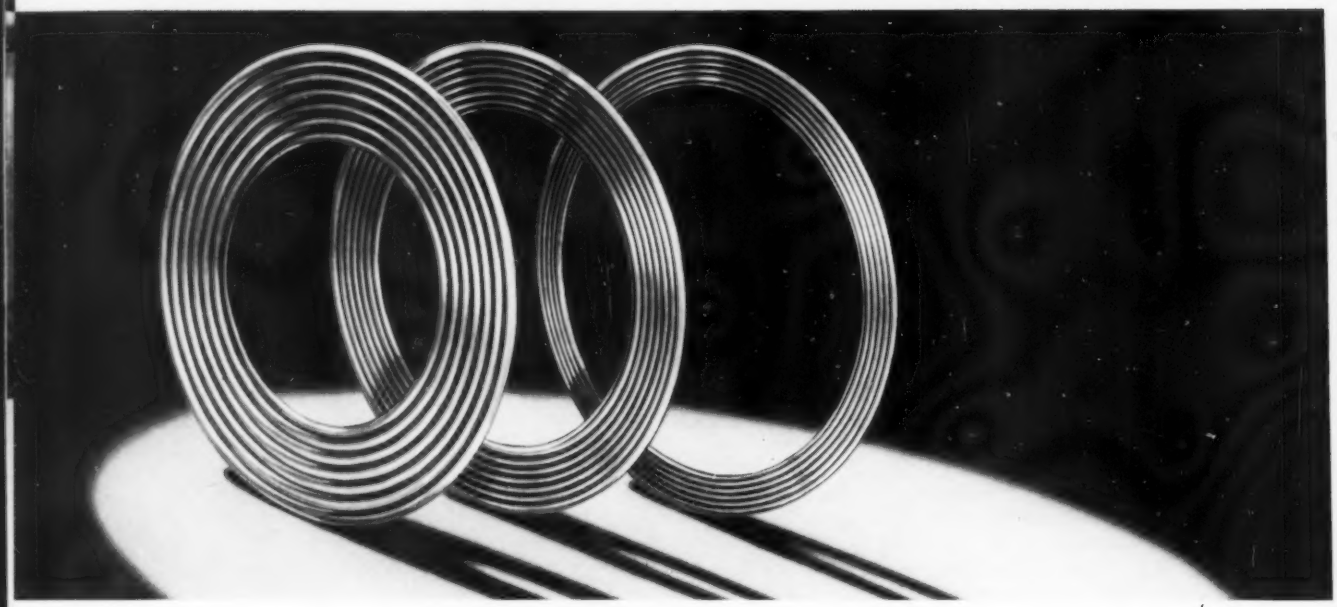
Kel-F retains most of its properties from minus 320 F (liquid nitrogen) to 390 F in unplasticized form, up to 300 F when plasticized. Plasticized form tends to harden at low temperatures; very soft at 300 F. "Cold flow" is low and "memory" excellent; both good gasket qualities. It deforms slightly under pressure, but returns if pressure is released.

Kel-F is molded in O, V, U and other shapes by compression, injection and extrusion methods. It's made into O-rings with resilient cores and laminated with glass fabric, silicone rubbers, asbestos, etc. Rubber and other materials are jacketed with Kel-F for corrosion and heat protection. Sheets, tubing or rods of Kel-F are cut, drilled and machined to close tolerances: also mechanically and electronically joined. Paper-thin gaskets and diaphragm sheets are also being made for corrosive acids.

Phenolic resins seal and insulate

When fibrous laminations (asbestos, glass fiber, etc) soaked with resin binder are heated and pressed, a chemical reaction is completed, forming layers into a solid mass. Once formed, it won't delaminate, won't usually resoften with more heat. Impregnating resin is permanently changed from fusible and soluble state to infusible and insoluble one. This resinous product is said to be "thermosetting."

With excellent dielectric strength, phenolic resins form combination gasket and insulation where current might be picked up and conducted into well piping, underground mains, etc. As shown in sketches, joint's bolts are jacketed. Gaskets may be simple ring, full with bolt holes, or covering raised face of joint only.



Metals make hard-hitting gaskets that can seal

Metallic gaskets are the "heavyweights" when it comes to tough sealing conditions. A wide variety of metals are used —alone, plated or coated against corrosion, or in combination with other materials. Materials and construction depend on pressure and temperature, corrosion resistance needed.

Metals. Before taking a look at the various constructions for metallic gaskets, let's line up the metals and their characteristics.

Lead is excellent against many corrosive agents but chemical solutions it seals must be near neutral point. Usually it's a good idea not to work lead at temperatures above boiling point of water. If used over 400 F, have groove in flange to prevent creep.

Tin is good for pure neutral solutions and foods, but acids and alkalis are tough on it. Can be pushed to 400 F, but is usually kept under 200 F.

Aluminum forms a protective oxide coating, but it is attacked by strong acids and alkalis. It's good up to 800 F, popular for sealing hot sulfur-bearing gases in the petroleum field.

Copper, next to iron, is most widely used metal gasket. Beware of attack by oxidizing acids, wet ammonia, some strongly corrosive substances like chlorine, sulfur, sulfur compounds. Don't use above 600 F. Exposure to hydrogen, carbon monoxide and similar reducing gases at high temperature embrittles copper unless it's deoxidized (made oxygen-free). If there's any chance of electrolysis, don't use copper between steel flanges.

Brass acts like copper in resistance to corrosion. High-zinc alloys may dezincify or corrosion-crack; right composition usually avoids this.

Monel is excellent at normal or high temperatures because it resists most acids, alkalis, and other corrosive agents. Don't use with strongly oxidizing nitric acid or strong concentrations of hydrochloric. It's tops for hot anhydrous hydrofluoric acid. Monel gets brittle in contact with sulfur-bearing gases above 500 F.

For steam, monel gaskets are OK up to 800 F; don't work above if subject to stress corrosion. Under ideal conditions, monel has been run at 1500 F.

Nickel won't stand up in all-around service quite as well as monel, but it's good to 950 F with chlorine. Embrittlement sets in at steam temperatures above 800 F if metal is under stress. Nickel is good in oxidizing atmospheres to 1400 F, can go even higher under controlled conditions.

Silver can stand 1200 F if reinforced to restrict creep. Wet corrosive gases like hydrogen sulfide and the chlorine group attack silver, but it resists alkalis, organic acids, and some concentrations of hydrochloric and other mineral acids. Because silver's resistance to corrosion doesn't depend on a protective oxide film, it stands up where such a film would be destroyed.

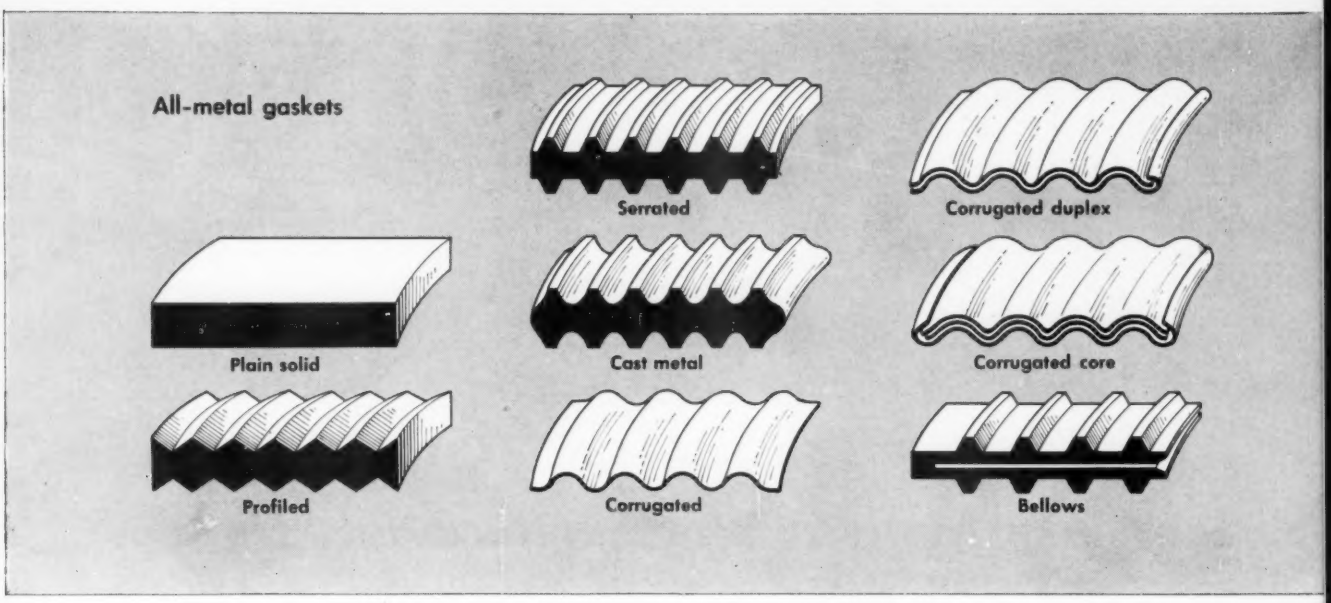
Platinum, because of its high cost, is used only when no other gasket material will resist corrosive action. Low oxidation rate keeps it going up to 2300 F in ordinary atmospheres.

Ingot iron and low-carbon steel (SAE 1010 to 1020) aren't good for crude acids or aqueous solutions of salts in neutral or acid range. These metals fail even in hot water if highly stressed. Iron and steel gaskets are popular for concentrated acids and most alkalis. Under oxidizing conditions, iron can be used to 1000 F. Reducing gases carrying sulfur are very corrosive above 600 F.

Chrome steel, Type 502 (with molybdenum: 4-5% Cr, 5% Mo) shows very good resistance to oxidation up to 1200 F. Corrosion resistance is better than that of iron.

Chrome steel, Type 410 (11-14% Cr) resists oxidation up to 1300 F, but 18-8 type stainless steels are more available.

Stainless steel, Type 304 (low-carbon 18-8) is the chrome-nickel steel most used for gasketing against corrosion. This steel is good for many chemical services where other metals fail—except for sulfuric acid and the halogens, es-



high pressures, temperatures, many chemicals ...

pecially when wet. Intergranular corrosion may start at 800 to 1500 F. For temperatures above 800 F, it's best to use a stabilized alloy for gaskets, such as Type 347.

Stainless steel, Type 347 (low-carbon 18-8, Cb stabilized) is a straight 18-8 steel with a small percentage of columbium added for better high-temperature characteristics.

Stainless steel, Type 316 (low-carbon 18-8 with Mo). Adding 2% molybdenum makes the 18-8 alloy stronger at high temperatures but intergranular corrosion may start in 800-1500 F range.

Gasket Designs. All-metal gaskets are made in a variety of forms: plain, profiled, serrated, cast and corrugated one-piece designs and a number of 2- and 3-piece built-up constructions (see the sketches above).

Plain solid-metal type can be made of any of the metals listed. Thickness starts at 0.002 in. and goes up to 2 in. for larger sizes. These gaskets can be machined to close tolerances.

Although most difficult of metal gaskets to seal, plain design is both efficient and economical, especially on flanges with concentric serrations. These gaskets possess great mechanical strength, good heat conductivity. For best service, thickness must be uniform, hardness right for the job and surfaces free of imperfections (tool marks, etc).

Profiled design is machined with concentric serrations to reduce bolt load need to pull gasket down in joint. Concentric lines of contact provide many sealing surfaces. By varying pitch of profile, gasket loading can be matched with bolt design. This type is used mostly for high pressures and temperatures in valve bonnets, cylinder heads and other narrow-face closures.

Serrated type is made of heavy solid metal machined with spaced concentric ribs. It's good where wide all-metal gasket with reduced contact area is needed, and specially good for high pressures and temperatures with standard raised-face flanges. Use only with smooth-finished flange faces.

Cast-metal gaskets are of softer molded-lead or lead alloys, with raised corrugations. Good for ammonia flanges or where a soft alloy is needed.

Corrugated gaskets of copper, monel, iron, soft steel, nickel, aluminum, lead, etc. are widely used. Generally made to fit inside bolt circle, they're also made for full face of flange, with punched bolt holes. Use on machined flanges for sealing against steam, water, gas, oil, chemicals, etc, under 1000 psi. Temperature depends on metal.

This type is also right for valve bonnets and other narrow-face joints, and for tongue-and-groove types. Corrugations are increased or decreased as needed. Makers recommend coating with a plastic scaling compound.

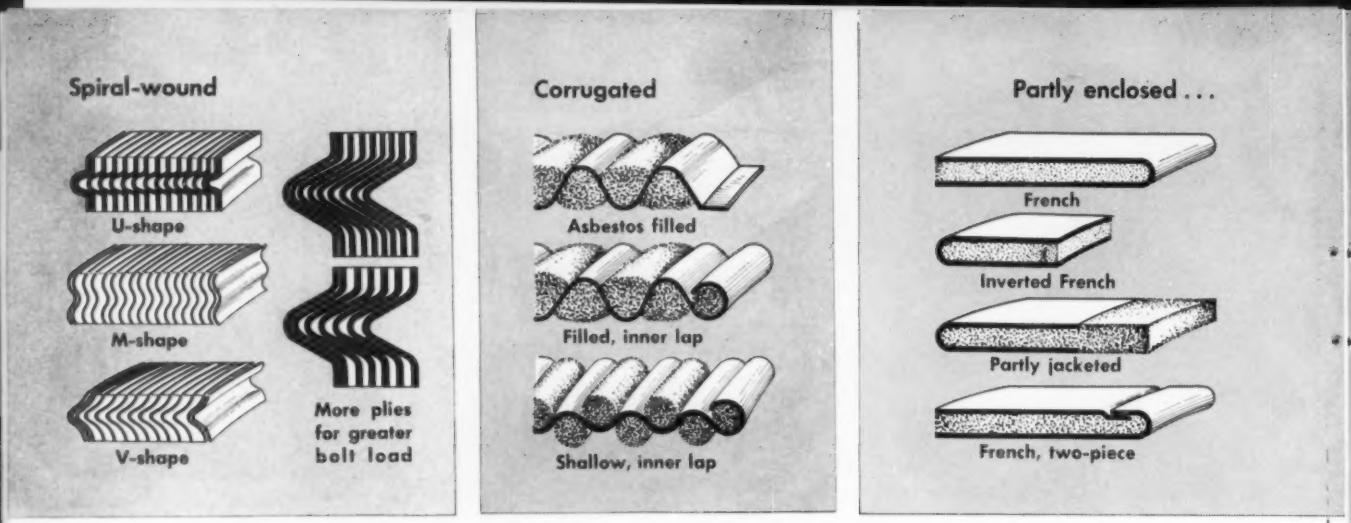
Corrugated duplex type is really two gaskets spun together by an inner lap. This gives twice usual thickness with extra thickness on inner edge. Duplex gasket can be used in place of two gaskets, which often slip when bolted up, making a faulty joint.

Corrugated (metal core) gasket is really three, with bottom one lapped over other two at both edges. This gives a more resilient construction useful for high-temperature service.

Bellowseal is made up of two 3/32-in. disks, each serrated on one face and welded together around outer rim. Place a thin compressed asbestos-sheet gasket over both serrations. Gasket is flexible enough to allow bellows action during sudden temperature changes, with pressure inside forcing gasket halves against flange faces.

Spiral-wound gaskets are a familiar example of types combining metal with other materials. They're made of a continuous strip of preformed metal, wound spirally from inside to outside, with filler cushion between each ply.

This construction makes a good all-around gasket, able to compensate for temperature shock and vibration. Besides multiple sealing action of metal



. . . combining metals with other materials greatly

strip edges, filler compresses under bolt load to make another barrier against leakage. Soft filler seals minute imperfections in flange faces.

Sketches above show construction of three types, all for the same service. When compressed, central U, V, or M spring-like metal strip is under tension. That compensates for expansion and contraction caused by temperature changes. Spring action helps to create and maintain a tight seal.

Asbestos filler is commonly used in the spiral-wound construction. Some makers use twin strips of filler on either side of metal strip to provide "air space" in center. Others fill all space between strips. Materials other than asbestos are also used as filler, including Teflon. The chemical resistance of Teflon combines with the strength of the metal to make a good gasket for high-pressure chemical-plant service. Metal strip may be monel, stainless steel, etc.

All the ferrous and nonferrous alloys can be used, depending on characteristics needed in service. Only requirement is that metal can be welded. Metals are often galvanized or plated with cadmium, etc. Brass, copper and other nonferrous metals are used—copper where good electrical contact between flanges is needed.

Compressibility can be varied—this can be important in solving problems in existing joints where bolt loading is already established. For example, two 5-in. lines have same size raised-face flanges. But one line is for 300 psi, the other for 900. Outside diameter of both flange faces is 7 5/16 in. The 300-psi flange has eight ¾-in. bolts, while the 900-psi one has eight 1¼-in. bolts.

To handle these differing bolting loads with gaskets of the same size, number of plies is varied. With more plies than used for the 300-psi flange, the gasket for the 900-psi joint can stand the increased bolting stress.

Besides varying number of plies to compensate for different pressures, compressibility of spiral-wound gasket can be controlled by hardness and resiliency of metal used.

Use spiral-wound gaskets for high temperatures and pressures as a general purpose gasket in flanged joints, valve bonnets, boiler-tube caps, handholes and manholes of many shapes and sizes.

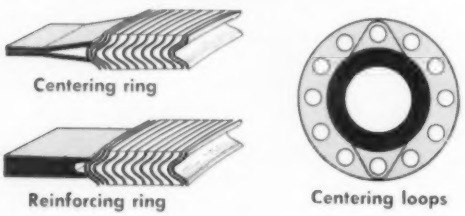
Other Combinations. In addition to familiar spiral-wound form there are a number of other gasket types employing metals in combination.

Corrugated-asbestos type has twisted asbestos cemented in metal grooves on both sides. When corrugations are flattened under bolt pressure, asbestos is held firmly against flanges. This thick gasket seals well on poorly aligned work, rough flange faces. It's also good for replacing asbestos millboard gaskets on ductwork joints under light pressure. Corrugated metal prevents large-diameter from breaking during handling, as would asbestos alone.

This type also comes with reinforced inside edge, shallow corrugations. Used widely on low-pressure liquid and gas service, below 600 psi, 850 F.

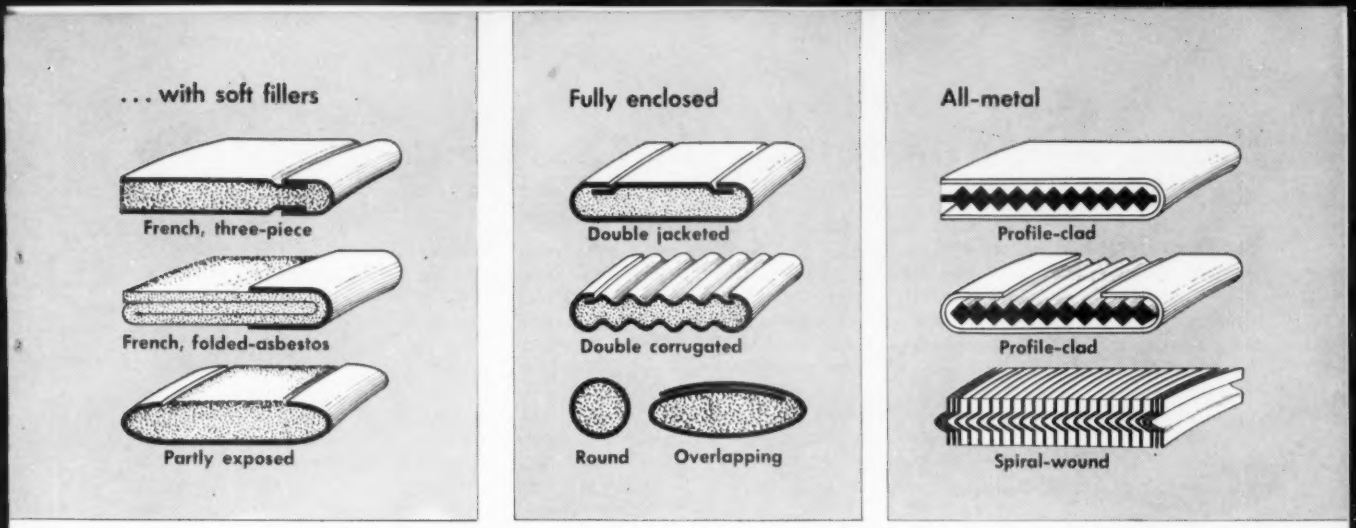
Partly enclosed combination gaskets have soft fillers, enclosed on all but one side. Known as single-jacketed type, they're mostly for cylinder heads and equipment applications needing more give, also popular on narrow joints.

Centering and reinforcing devices



Ring gaskets may be centered in the bolt circle by a centering ring on the outside. Inside centering rings are for use on manhole plates having no positive shoulder, or plates made so gasket may cock. Loops that slip over bolts (sketch) form another centering device.

Reinforcing rings of solid metal do three jobs: (1) They prevent lateral expansion of gasket when compressed. (2) As ring thickness is right for gasket's loading, they act as a compression gage. When flanges are pulled up to touch ring, bolts are properly loaded. (3) They serve for centering.



extends their range of usefulness for sealing

Filler may be rubber, asbestos, other materials.

Fully enclosed type comes in many shapes—sketches above show some popular designs. Cushioned effect of soft filler permits proper sealing, while full metal jacket stands up under high pressures and temperatures to 850 F.

Fully enclosed gaskets are used often where joint is broken frequently and gasket is reused. They are available in intricate shapes — such as valve-chest covers with various-shaped ports, etc. Round cross-section shown is for smaller plugs or caps that are screwed down against gasket.

High Pressures, Temperatures.

When you start sealing pressures in really high ranges, and at high temperatures, you run into specialized forms of metal gaskets. Most of them appear simple but depend on precise design for good results.

Features of a good high-pressure flanged connection are: (1) tightness under pressure and temperature fluctuations and usual piping stresses from torsion, bending, vibration (2) no effect from minor pipe misalignments or from slight surface flaws on gasket or flange faces (3) lightest possible joint weight by putting gasket pressure area near inside diameter of pipe; high unit pressures on gasket seat with low bolt loads; partial self sealing at operating pressure, if possible (4) enough bolts so if tightening fails one, joint won't fail.

Oval and octagonal designs shown below, used to 15,000 psi and 1600 F, are solid metal rings, for specially grooved flanges. Both are designed to give a pressure-tight seal at low bolt stresses. Rings and flanges must be machined to close tolerances. Hardness of gasket must be right for flange to insure proper gasket flow without damaging flange surfaces.

Lens type is simple, clamped between pipe ends. Here a spherical gasket surface contacts conical pipe ends. As with all metal-to-metal ball-and-cone joints with small bolt load, contact area is very small and gasket seating pressures are very high.

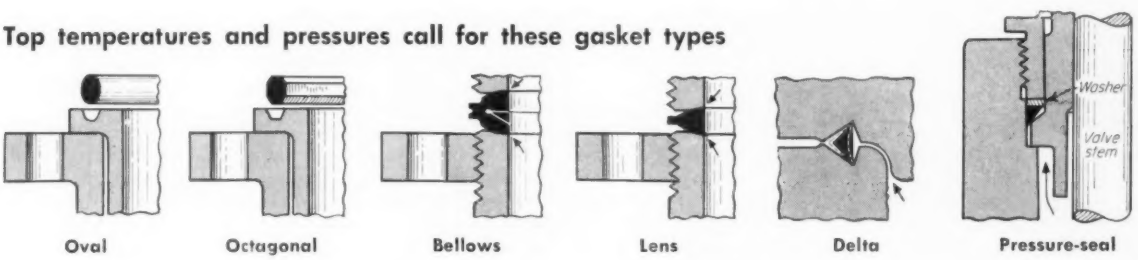
With gasket softer than pipe, action under load is both plastic and elastic. Most deformation is elastic and is both radial and axial. Ball-and-cone shape allows lens to seat under slight misalignment. Even minor scratches or tool marks won't cause leakage. Brinell number of ring can be 30 to 40 points below piping material, as ring is easier to replace. Some engineers however, want rings of pipe material, or harder.

Bellows type lens ring has still greater self-sealing effect because fluid under pressure enters annular space in lens and acts over greater area. If bending movements tend to open mating flanges, bellows lens opens to follow seating surfaces. Use this type for pressures from 10,000 psi and up.

Delta type is for sealing flanged ends of vessels under high pressures—from 4000 to 30,000 psi. Internal pressure forces entire soft-iron gasket to expand when pressure forces bolted head away from shell; dotted lines show shape gasket takes. Then sealing is not at tips, but near them.

Pressure-seal type is made of soft iron, copper, or steel, and is used in high-pressure valves and pressure-vessel heads. Inside pressure forces against ring, making a self-energized seal.

Top temperatures and pressures call for these gasket types



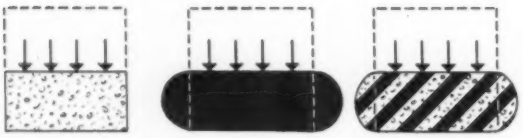
Some other materials that serve as gasketing

Vegetable fiber with different binders forms sheet gasketing often referred to as "paper." Fiber and binder are compressed into a homogenous structure, then treated with a glycerol-base compound. The resulting sheet material comes in thicknesses from 0.006 in. to ¼ in. Thicknesses over 1/16 in. are built up in plied construction. This gasket material is used for oils at low pressure and water up to 212 F. It is generally good for flanged pipe joints at the lower pressures.

Vegetable fibers are also combined with cork and rubber. For sealing light petroleum distillates, use gaskets of fiber with buna-S saturant. The fact that oil causes fiber with buna-S saturant to swell may be an advantage, as it then seals tighter. Swelling in this fashion doesn't damage the gasket.

Improved processing now makes fiber gasket materials resist drying out, hardening or shrinking in service. The fibers are treated with water dispersions of rubber or resin, thus distributing an even coat over each fiber *before* the sheet is formed. Combining different types of fibers, saturants and fillers creates an almost unlimited range of materials. Since this new process locks each fiber in an even coat of latex saturant before the sheet is formed, rubber-to-fiber ratios are much higher and the material is more uniform.

In addition to vegetable fibers, asbestos fibers are also used in making sheet gasketing by this process. Fibrous materials of the cellulose type usually seal at lower loads than the asbestos type. But asbestos withstands higher temperatures. Cellulose materials are good to about 250 F, while asbestos can take it up to about 750 F, depending on the service. At this temperature, the rubber binder will carbonize, but the asbestos fibers remain well interlocked and felted together. Fiber is economical gasketing.



Cork is oak bark, composed of numerous tiny cells separated by thin but tough membranes of resinous materials. Most of raw cork's volume in sheet material is due to air trapped in these cells. Gasket sheets are made of ground cork, the granules being held together with a resinous or rubber binder, depending on service needs.

Granulated cork is also combined with vegetable fiber and an oil-resistant binder. Use these sheets against oil and solvents up to 212 F, on flanged joints of gear cases, oil pans, etc.

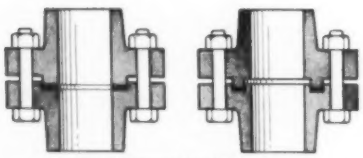
Compressibility of cork-and-rubber combination is sketched (*left*) in comparison to cork and rubber alone. Combination shows excellent resistance to fatigue. It doesn't easily stick to metals, so works well where opening is frequent.

In cork-rubber materials, rubber binder encloses each cork particle in a continuous matrix. Gasket made this way seals high internal pressures on flanges designed to prevent blowout. Depending on composition and fluid gasket is exposed to, cork combined with synthetic rubber is used to 300 F.

Solvent resistance of cork-and-rubber is about the same as for straight synthetic rubbers. Cork and neoprene is often used with lube oil, etc, where some swell is OK.

Cork-and-buna-N displays good resistance to gasoline and aromatic solvents, has less tendency to swell or stick to metal. Cork-and-thiokol compositions have good solvent resistance but can't stand higher temperature ranges.

Surface friction runs high with all cork-and-rubber combinations. This retards slippage, even on oily flanges, and prevents excessive extrusion from between flanges if gasket is overtightened. Various binders help cork do many tough jobs.



Recessed flanges for high pressure

Leather is one of the oldest sealing materials. It's a natural product of interwoven fibers forming a fabric that's pliable, tough, and highly resistant to abrasion and wear.

Three basic ways of tanning leather are: vegetable, mineral and combination. Vegetable tanning is done with tannin extracted from fruit, leaves, bark, wood roots. Usually, any vegetable tannage is called "oak" tannage. Mineral tannage is generally done with chromium salts. The combination method employs both of these proven tanning materials.

Vegetable-tanned leather commonly runs denser than mineral-tanned; it weighs more and its structure is more compact. Mineral-tanned leather is usually flexible, offers greater resistance to heat and destructive action of chemicals. For low-pressure service, leather is often impregnated with oil, grease or soft wax. For extremely high pressures, it can be made rock-hard.

Leather seals many pressure mediums over wide operating ranges. Among them are: water, vegetable, mineral, fish, and animal oils, alcohol, oxygen, air, glycerin, gasoline, kerosene, many other noncaustic, nonacid fluids. But most common are air, water and mineral oil. Sub-zero temperatures won't crack, break or shatter leather. Mineral or retanned leather can be used up to 200 F, depending on the impregnation.

Never use leather for sealing acids, alkalis, or steam under pressure. For oil, mechanical leather must be processed for resistance, otherwise filler or impregnant may dissolve, leather fail.

Rubber-impregnated leather, a new product, combines lower friction and greater strength of leather with perfect sealing, resilience and heat-resistance of rubber. Long-fiber mineral-tanned leather is completely impregnated with a synthetic rubber, so rubber goes all the way through, doesn't stop on the surface. Result is a pliability found only in rubber gaskets.

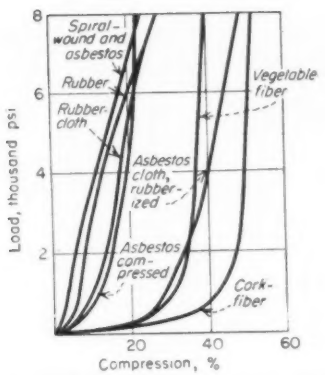
Leather gaskets are applied in plain-faced flanges at low pressures. For higher pressures, flanges are recessed on one or both sides, *sketch*. All gasket applications depend on initial tension of bolts. For hard leather, limit compression to 15% of gasket thickness; for soft leather, hold compression to 20%.

14 practical tips for best results with common gaskets

1. Remove corrosion and burrs from seal surfaces. Make flanges parallel as possible. If warped, reface flanges so gasket compresses evenly over its area
2. Select right gasket for job conditions, using ring type where possible. Use a quality gasket—cost is small compared to down time and labor
3. Use thinnest gasket possible, but try thicker, softer one where rough faces can't be machined smooth
4. Put in a metal spacer with a gasket either side if flanges are too far apart. For high pressures particularly, that's safer than a very thick gasket
5. Don't make gasket by hammering on material against flange. That "lumps" material, may keep flanges from seating Use a good gasket cutter
6. Cut bolt boles slightly larger than bolts so gasket won't bulge around bolts, prevent proper seating
7. Size gasket right or exposed flange faces may corrode and need machining next time joint is opened
8. Make gasket ID just slightly more than ID of line. This keeps hydrostatic end force to minimum; flow won't be obstructed by gasket squeezing into line
9. Graphite one or both sides of gasket if joint must be broken at times. Mix graphite with water, never with oil, which attacks any rubber in gasket
10. Smear graphite paste on bolts and run nuts down before making up joint. Replace faulty bolts and nuts
11. Tighten nuts in right sequence (p 107) to load gasket evenly. Tighten again at operating conditions
12. Cut down inventory by standardizing as far as possible on gasket materials and thicknesses
13. Shellac gasket to housing on crankcase doors, strainers, etc, that are opened often. Smear cup grease on other side of gasket
14. On flanges with coarse tool marks or scratches that form paths for leakage, interrupt paths by machining a circular V-groove in both flanges

MOST IMPORTANT: Consult gasket maker when you run into a problem

Keep these facts in mind when you use gaskets



Compression effect on common gaskets

For good sealing, you need to know by what percentage gasket thickness reduces under various loads. Crushing strength of gaskets varies with material, thickness and temperature. Information of this kind can be had from makers.

Simplified chart, *above*, shows that a spiral-wound gasket with asbestos layers, for example, compresses about 11% under 4000-psi load, while cork-fiber sheet compresses about 50% under the same load. Here's the answer to a common cause of leaks in bolted flanged joints—insufficient bolt pressure. Gasket must be loaded right, but if bolting won't take increased load, answer may lie in another type of gasket material.

Assume, for example, a joint sealed with a compressed-asbestos sheet. Uneven flange sealing surfaces cause leaks. Chart shows that at given bolt load, 4000 psi, asbestos sheet compresses only 19%. But asbestos cloth compresses 36% for same load. Change to the cloth should solve the problem.

How about gasket paste?

Paste is often used to separate gasket and flange so they don't stick when joint is taken apart later. This paste is usually made by mixing graphite or mica with water. But some use what might be called a sealing paste to make a joint fluid-tight and that's where the argument starts.

Sealing pastes may be classified roughly as (1) soft setting and (2) hard setting. First group includes compounds based on linseed or castor oil, soaps, asphalt, rosin, shellac, etc. Rubber gaskets absorb most such compounds, but on nonrubber they may form a viscous separating layer that helps to seal the joint.

Hard-setting group includes compounds of portland cement, magnesium oxychloride, plaster of paris, litharge-glycerol, sodium silicate, shellac (at low temperatures) and sugar (at high temperatures). These usually expand when set, bringing more pressure on gaskets and helping to build up pitted surfaces.

Main weakness of hard-setting pastes is their tendency to crumble as joint contracts and expands under pressure and temperature. Resulting granular layer prevents intimate contact between flange and gasket, spoils seal.

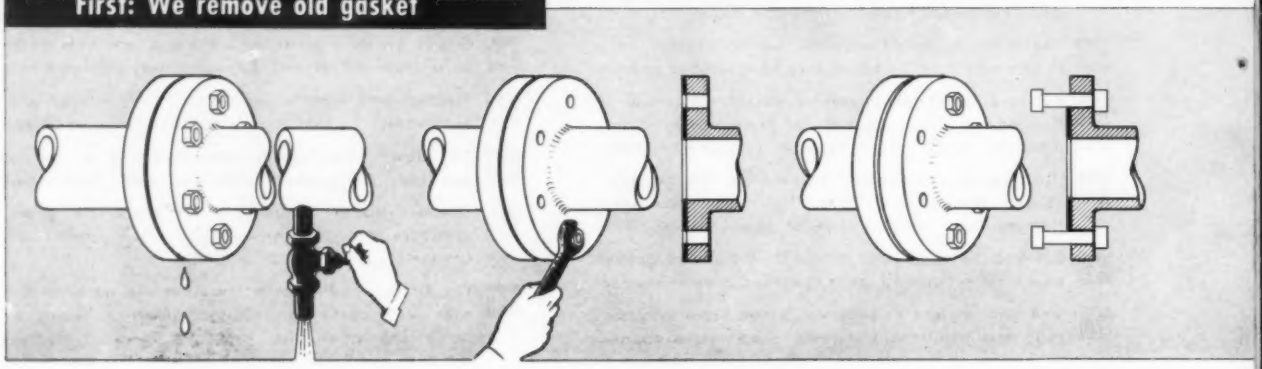
A gasket made of properly compressible material needs no sealing paste, say its opponents. Weight of informed opinion runs on their side.

Turbine-Casing Joints. For these metal-to-metal joints, brush on triple-boiled linseed oil before bolting. Or use either type of paste. Thin asbestos twine (1/32 in.) can be run inside bolt line (*photo*) to fill irregularities.

Paste and asbestos twine seal casing

Right Way to Remove, Lay Out,

First: We remove old gasket

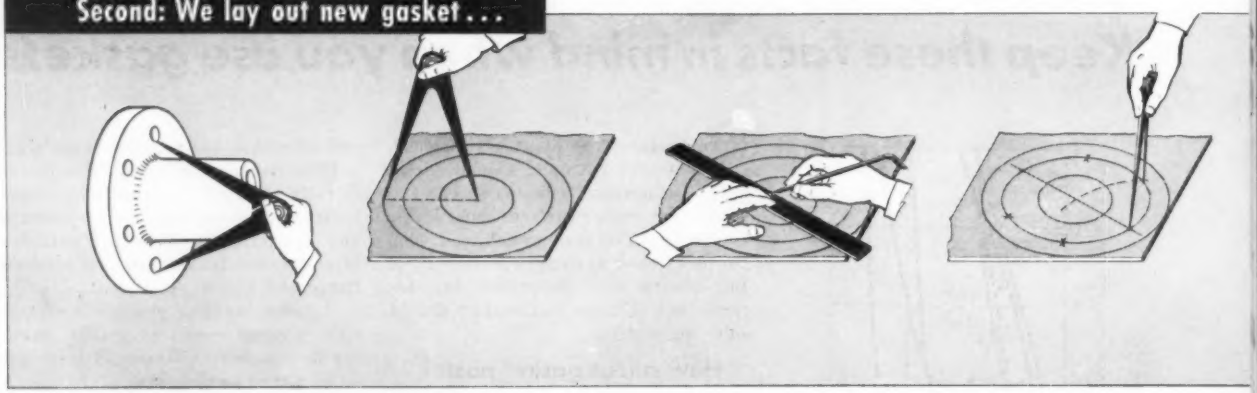


1 Open drain to relieve pressure before breaking any pressure-vessel joint

2 Remove all bolts if flanges are sealed with a full gasket (shown at right)

3 If gasket is ring type, remove only enough bolts to slip old out, new in

Second: We lay out new gasket . . .



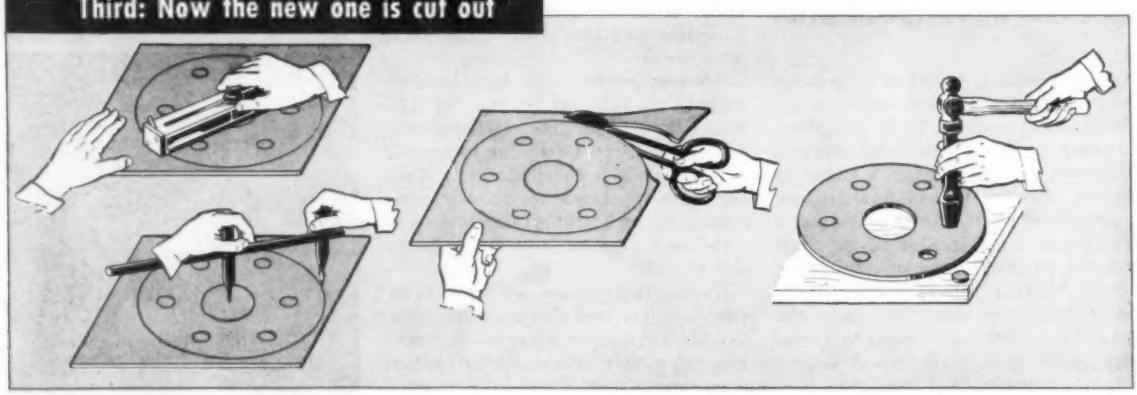
1 Bolt circle is found from bottom (or top) of holes

2 Radius of bolt circle is equal to half of diameter

3 Draw line through circle's center for opposite holes

4 On 6-hole flange, radius is distance of bolt holes

Third: Now the new one is cut out

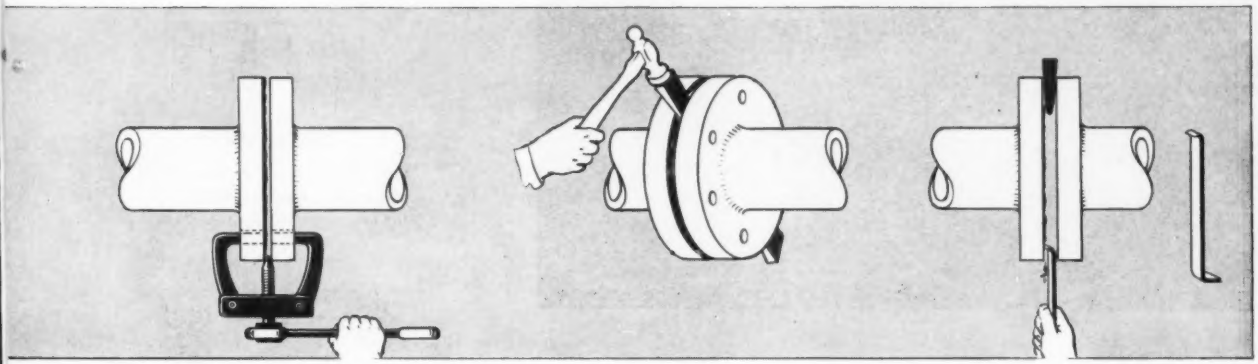


1 Gasket cutters turn out clean holes fast. Top unit needs only one hand

2 Tin snip is next best way. Never hammer gasket as that causes lumps

3 Punch holes after placing material on hard wood to protect the punch edge

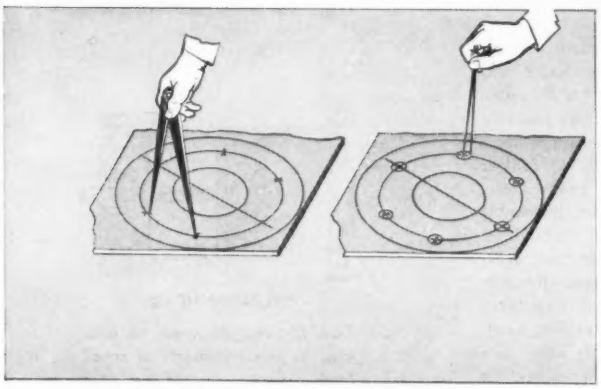
Cut and Install Your Gaskets



4 Flange spreader: handy to open joint. You might require two on some jobs

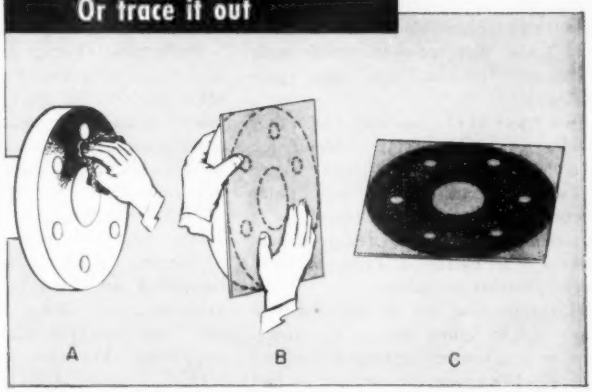
5 Steel wedges, driven in at opposite edges, take place of flange spreader

6 Scrape out old gasket. Be sure every particle is removed. Don't harm face



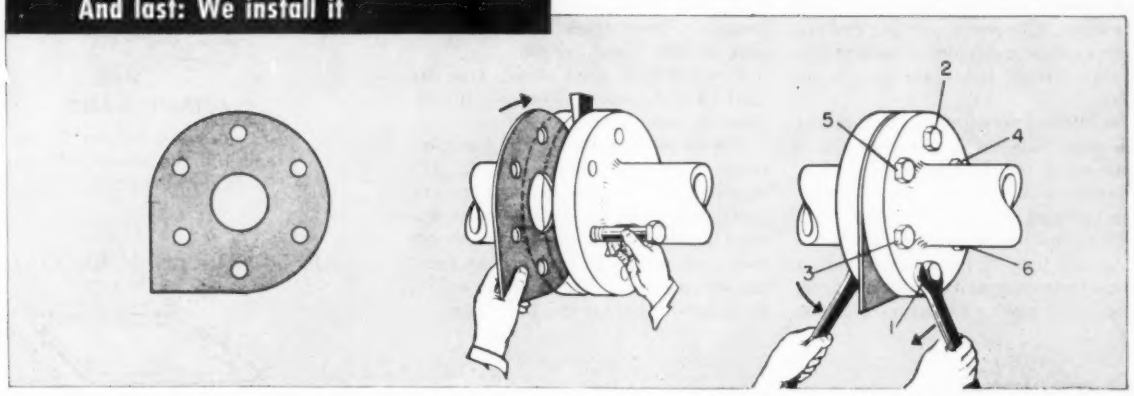
5 To check distance, walk dividers around the circle. Lay out holes a little larger than their actual size

Or trace it out



TRACING a gasket's form (if you can get at flanges) is often faster. *A*, graphiting the flange; *B*, making impression; *C*, finished

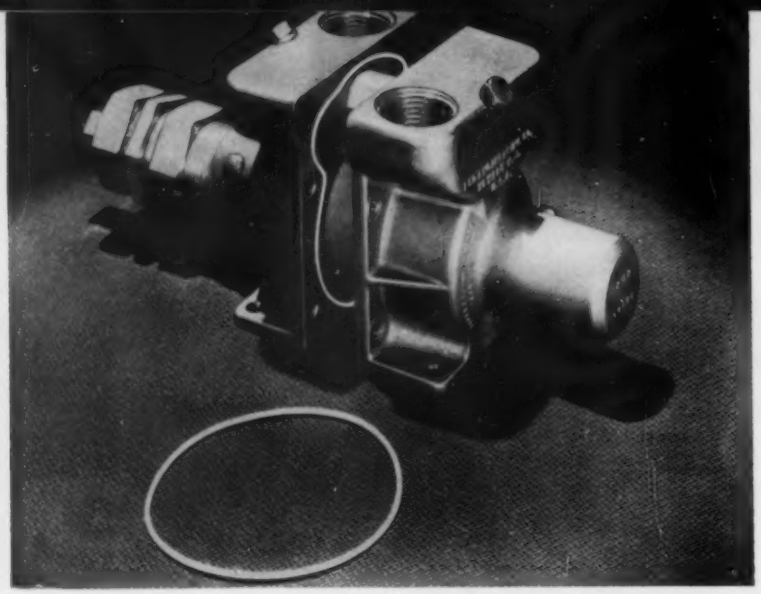
And last: We install it



1 Leave one corner on gasket so you can hold it for positioning in flanges

2 Slip one bolt through flanges and gasket. Position gasket, place bolts

3 When line is under full pressure, tighten again in the sequence shown



And don't overlook O-rings

O-rings seal over a wide temperature and pressure range, are simple and dependable. Today they are used widely, both as dynamic (packing) and static (gasket) seals.

Two types of O-rings are: (1) radial interference (2) axial interference (*sketches*). Use radial type where adjustment or positioning of metal parts independent of sealing considerations is required. Good groove design avoids failures from extrusion, excessive wear due to pressure pulsations.

Axial-type ring can be installed in a groove cut in flange face, in a counterbore, or in an irregular-shaped opening (*photo*). Big advantage comes from fact that little tension is needed for low-pressure sealing; pressure forces ring against joint. Need for groove in flange is disadvantage.

At high pressures, prestress the bolts only enough to keep joint faces from separating. Compared with flat gaskets, where extreme tightening is needed just to retain gasket, procedure here is opposite.

For internal pressure, use counterbore with same diameter as OD of ring, and depth equal to minimum ring section, minus recommended static-seal interference (amount ring is squeezed).

With pressures below atmospheric, as on suction lines of pumps, etc, add an internal retaining wall to keep ring from being pulled inside. Rectangular-section groove is usually best for most static O-ring jobs.

Materials. O-rings are made of various types of rubber, Teflon, Kel-F and other plastics. To get best results, give maker as much information as possible about operating temperatures, pressures, fluid sealed, metals involved, etc. Maker can then select material, groove, etc.

Metallic O-Rings. For metal-to-metal joints where expansion and contraction of jointing surfaces must be met, pressure-filled rings may be used. Ring is made of metal tubing, filled with inert gas. Tube may be mild or stainless steel, copper-nickel or other copper alloy, any weldable material. Gas pressure is around 600 psi.

Single ring is commonly used, but for extremely high pressures two or three rings may be needed deeper in groove. Pressures up to 20,000 psi at room temperatures have been held for long periods. These rings have also been used at 1000 F and 250 psi.

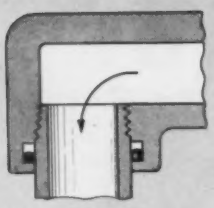
Pressure-filled rings of this type are used for high-pressure hydraulic piping, diesel cylinder heads, etc.

Woven packing for stuffing boxes becomes gasketing when so used. It's excellent for sealing manhole covers, doors, etc. With a variety of cross sections to choose from, even extremely uneven surfaces can be sealed. Run packing around inside bolt circle (*sketch*), tie ends with light twine, bolt down.

ACKNOWLEDGMENTS

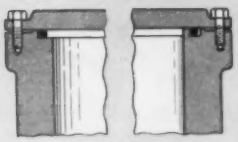
For technical data and illustrations used in preparing this manual, Power acknowledges the wholehearted cooperation of the makers of gaskets. We specially thank J J Catteral, H H Dunkle, F C Morton, J H Swartz, R Van Ness and R C Zimmerman for personal discussions on various gasket problems

HERE ARE A FEW O-RING GASKET APPLICATIONS



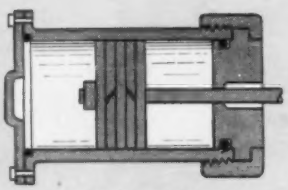
RADIAL SEAL

Use where parts to be sealed might need adjustment—like turning pipe in O-ring, above



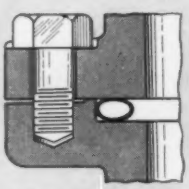
AXIAL SEAL

Counterbore *(left)* for internal pressures only. Use groove *(right)* for vacuum and pressure



CYLINDER HEADS

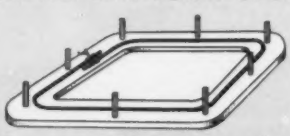
Two O-rings do work of gaskets in sealing heads of small high-pressure liquid cylinder



METALLIC O-RING

This gas-filled tubular O-ring seals flanges, diesel cylinder heads, handles tough jobs

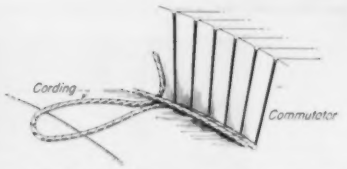
PACKING CAN FORM GASKET



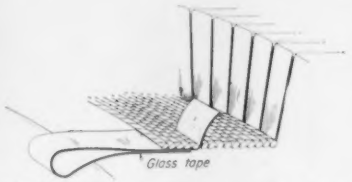
MANHOLE SEAL

Run a piece of braided packing around opening, tie the ends to make a serviceable gasket

V-RING STRING BAND is applied with normal tension, then pushed in final position with fingers. About one-quarter of band is run on before glass loops are spotted



TO START BAND form big loop with end of cord anchored under the first turn



GLASS TAPE at several points around the periphery serves to pull cord-end snug

Use Glass Cord to Build Up Commutator Ring

By R E BROWN, *Engineer*
National Electric Coil Co

► PRIMARY REASON for covering the exposed portion of a commutator V-ring is to protect and preserve the mica from carbon, dirt and other damaging particles. In addition, this practice keeps the mica from flaking apart when armature is operating.

Covering consists of a string band, applied tightly, and finished with several coats of varnish. This forms a slick finish that prevents accumulation of foreign matter. First time to apply or replace these bands is before the armature is wound. But a band can be replaced when needed.

Setting Up. To start, place armature in a stand or rack where it is easily turned. Remove the old string band. Replace the mica V-ring if condition isn't topnotch. With asbestos compound, level off shoulder base, filling in all crevices to assure a smooth base surface for the string band.

Most suitable banding to use is 1/32-in. untreated glass cord. Start the band by leaving a little excess cord so a loop can be made as shown in top sketch. This loop must be large enough to hang over front of the band. Anchor end of cord or loop under the first turn with loose end between commutator and first turn.

Rotate armature until about a quarter of the band is completed. At this stage, place four pieces of untreated glass tape, preferably ½ in. wide, equally spaced around periphery of the V-ring with the end of tape protruding between turns and with the *cord* loop midway between two glass-tape loops. Continue banding until cord is within one turn from end of the band. Then after allowing enough to finish, cut cord and slip the end through all five loops, finishing with the cord loop.

Holding the finish end taut, pull cord's starting end until loop catches finish end of cord. Work it under a sufficient number of turns to hold it fast. Tighten remaining four glass-tape loops by pulling loose end of tape taut. Do not pull cord under the band with the cord loop, but tighten it only enough to hold last turn snug against remainder of band. Trim all loose ends of tape and cord close to band.

Finishing Touches. Brush on a mixture of asbestos compound thinned with varnish until it is about the consistency of thick paint and the cord band is thoroughly saturated. Then place the band in an oven. If the armature has equalizers that require hot banding, the ideal time to bake the front band is while heating equalizers.

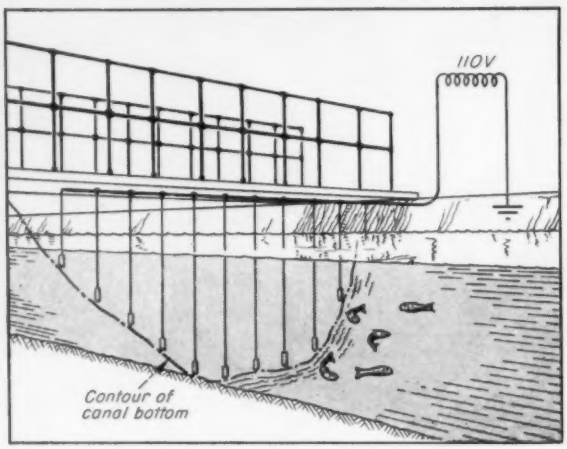
After the armature has been removed from the oven and cooled, sand the band with a fine grade of sandpaper until smooth. Then apply a second coat of compound and varnish mixture, and bake. This baking may be done with the heating of the armature coils for hot banding.

Remove armature from oven and again sand the string band until perfectly smooth. For the third time, paint with the mixture, bake, and sand smooth. Then apply two coats of thick insulating commutator enamel with brush, sanding between coats. Finish band with a thin spray of the same red enamel. This operation leaves the band with a hard, smooth, durable surface that is easily cleaned by wiping with a soft cloth, keeping out dirt and carbon and insuring longer life for armature.

Don't overlook this seemingly small step in your maintenance or repair operation. The technique can be applied, with some revamping, to other phases of your electrical department outside of motor repair and rewinding. Typical is in the lacing up of control wires as they are fanned out of a cable.

Here the aim is to add rigidity and order to the individual wires before they are fastened to their binding posts. Of course, many of the steps outlined above are elminated, such as painting with the asbestos compound and baking. The varnish, however, is usually applied quite carefully after the cable is in its final position and each wire laid in place. Finished lacing will speed trouble-shooting by holding wires snug.

12 PRACTICAL IDEAS *to help cut your rising...*



Shovel or Fish Fence—What's the Right Answer?

EDITOR'S NOTE: *Here are two problems of the same general nature. If you have licked a similar headache in your plant, send us illustrations and data.*

Only one of seven generators could operate last winter at Avon Lake Station in Cleveland. Millions of gizzard shad plugged intake screens. Fastest way to get them out was with a shovel.

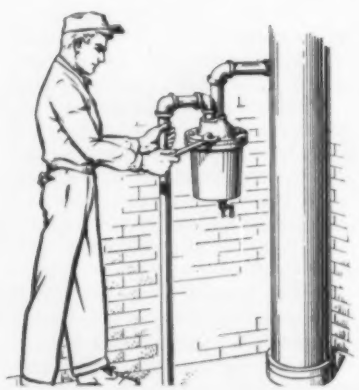
The fact that sudden temperature drop in Lake Erie surface waters stunned or killed the fish was of little help to the operators. But the fact that weight of the fish collapsed the screen, drawing them into condensers, did give the men one big headache.

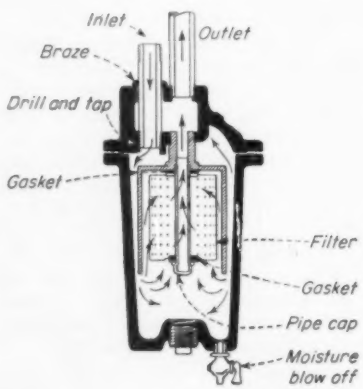
Dynamiting offshore to break up schools of fish helped some. Divers also went down to clean the screens. Where a problem of this kind comes up once in a blue moon, plants usually do little about preventing fish from shutting down the works.

Fish trouble also occurred at Conners Creek Plant of Detroit Edison Co some time ago. A run of shad plugged water passages in the condensers. Someone suggested an electric fish fence, sketch. Fence was installed in the canal.

Fish made a return engagement as soon as fence was built. And they brought their relatives with them because water around the fence looked like a black churning cloud. But this cloud ended sharply four to six feet from the live fence.

Braver fish that tried to get past the blockade ended up at water's surface on their backs, then fluttered crazily away. Fence gives some trouble because debris catches on suspended electrodes, but work on this problem goes ahead.





Air Filter Made of An Old Steam Trap

WE BUILT AN AIR FILTER for air-operated controls from an old steam-trap body and an automobile oil filter. Dimensions are not given because size of this filter will depend on the size of the trap body, but it works very well.

The ¾-in. inlet pipe is screwed through the original 1-in. opening into a tapped opening in trap cover's partition.

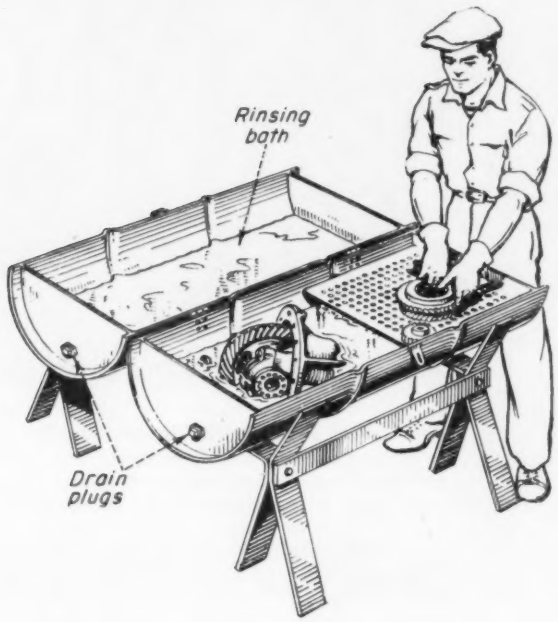
This hole must be both drilled and tapped through the 1-in. opening. After the ¾-in. inlet pipe is tightened into place, braze it to top of cover so it's pressure tight.

Air flows through this nipple and over a welded steel sleeve, picking up velocity in restricted area between inside of trap body and sleeve. Increased velocity at this point tends to throw out particles and water droplets. Passage of air through the oil filter helps remove rest of moisture and oil. This filter permits a periodic changing of the filtering elements.

Daily blowdowns at blowdown connection remove accumulated moisture.

C TRETINYAK *Rochester, Minn.*

STEVE ELONKA, *Associate Editor*



Oil Drum Makes Handy Cleaning Tank for Solvent

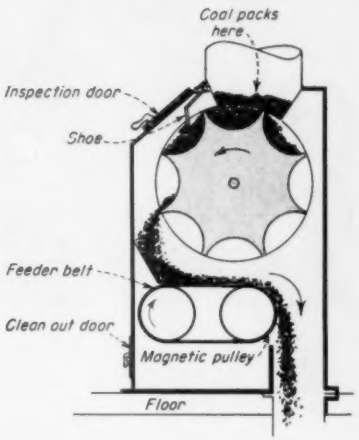
CLEANING GUNK AND GOO from machinery while overhauling is always a headache. And unless machine parts are properly cleaned with solvent, dirt going back into critical parts often causes failure. Besides, dirty parts should be cleaned when you are taking them apart.

We solved problem by building a cleaning tank from an oil drum, sketch. To make, chisel drum in two, then hinge halves together. Build a stand for bottom-half so cover-half opens and rests on stand. Thus, it can be used for rinsing bath. Then drum does double duty.

Perforated shelf shown is for working on parts while they are drying. Cleaning solution, such as lye or any commercial solvent used for bath, drains back into tank from this shelf. After rinsing parts again, place on shelf for drying.

Steel stand enables you to use a torch or oil pot under bath for quick action needed for some solutions. When not in use, drain the solution back into storage and lock the drum.

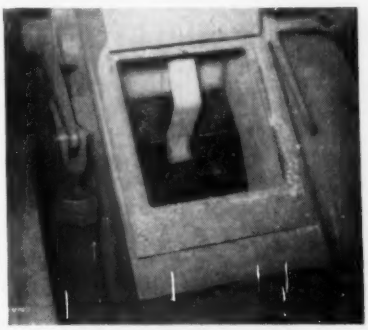
C H WILLEY *Penacook, N. H.*



Alarm Warns of No Coal in Feeder

WE HAD SOME TROUBLE with coal plugging and arching above drums in our drum-type coal feeders for pulverizers. System had alarms to warn us when there was no coal in automatic scales or chutes. When flow plugged in feeder, drum ran empty and mill was without coal.

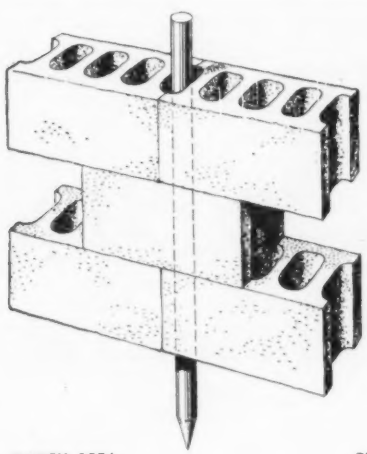
To warn of this condition, we built an alarm. We drilled a hole to fit a ½x2-in. flat iron, through boss in side of feeder, bent a shoe into the shape shown, and welded it to shaft. End of shoe rides on surface of coal in drum pockets before it's dumped to feeder belt, photo.



If pockets run empty, shoe drops to bottom of pockets, sounding an intermittent alarm. Alarm circuit is connected to existing alarm horn on chute. Steady sounding of horn indicates no coal in chute. Intermittent sounding indicates no coal passing through feeder. Cutoff switch is connected to feeder alarm circuit so alarm may be cut off when other fuels are burned.

C TRETINYAK *Rochester, Minn.*

(*Continued on page* 128)



Reinforce Those Concrete-Block Walls

CONCRETE BLOCKS are often used in small plants for building coal bunkers, etc. Only trouble is that blocks won't stay put when they are used as retaining walls.

Solution is to drive old 2-in. iron pipe through them about every ten feet of their length, as shown in the sketch at the left.

Because piping takes load, mortar between blocks won't crack and walls are strong enough for most services.

D B CLAPP *Irvington, N. J.*

More PRACTICAL IDEAS

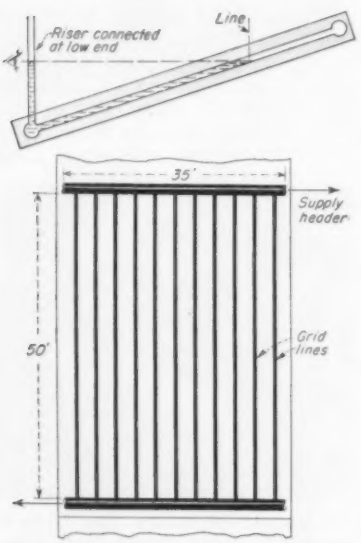
Begins on page 126

Inexpensive Plastic Pipe Carries Corrosive Well Water

CAROLINA POWER AND LIGHT Co has installed a quarter-mile length of butyrate plastic pipe to carry well water saturated with air and a high percentage of CO_2. The 3-in.-ID pipe comes in 20-ft lengths. They are joined by slip-sleeve couplings and a solvent cement, giving in effect, a welded joint. No threading is needed for joining.

The pipeline was installed in less than half the time needed for a conventional one. Coupling can be done quickly, and the light weight makes the piping easy to handle. The plastic piping costs about half that of a conventional line originally considered.

The water line will run at 50 psig and is buried 30 in. below grade. Before covering the line it was tested up to 70 psig. Where the line runs beneath a railroad it was placed inside a short length of concrete conduit to protect it from excessive external loads. Each 20-ft length of pipe weighs 23 lb. An ordinary handsaw for wood can be used to cut the lengths as needed. *Courtesy, Eastman Chemical Products, Inc.*



Finding Leak With Isotopes

CONCRETE RAMP at our meat-packing plant is radiant heated. Ramp is in sections, each 50x35 ft, and each has its own heating grid. Grids consist of supply and return header, with pipes connected in parallel between them, sketch. Grids are completely encased in concrete slabs, with control valves in boxes at ramp's edge for isolating sections.

One day the grids sprung a leak so we put pressure tests on each grid until we found the faulty one. Then came question of what to do about it. Opening 1700 sq ft of reinforced concrete to look for a leak is expensive—takes time. Of course, leak had to be pinpointed.

We tried various listening devices, but heavy commercial traffic noises in vicinity kept us from getting good results. Because of ramp's slope we did find *level* of leak. This was done by connecting a riser to outlet at low end, sketch, filling grid with water and allowing it to seek its own level. We could then sight the slab at this level and draw line on concrete. Leak had to be on this line. But we still didn't like idea of breaking slab along this line till we found leak.

Here was the place for isotopes. We reasoned that by filling grid with water and injecting a shot of radioactive liquid, it would eventually have to run to leak. Because of danger of isotopes, we got a firm specializing in this work.

They filled grid with water. Then they placed a slug of radioactive isotopes in a water solution and injected at high end. We followed isotopes with Geiger counters. There was some dispersion, but there was a definite flow down one pipe to a point beyond which no activity was noted. Point was on line we had drawn on slab at level of leak.

On basis of these observations, we opened concrete at this point and, when pipe was exposed, found the leak.

So all we did was dig a hole about two feet square, cut out bad section of grid and weld in new section, test and fill hole. And we saved time and money.

K POINT *Chicago, Ill.*

Paper Bags Protect Emergency Lanterns

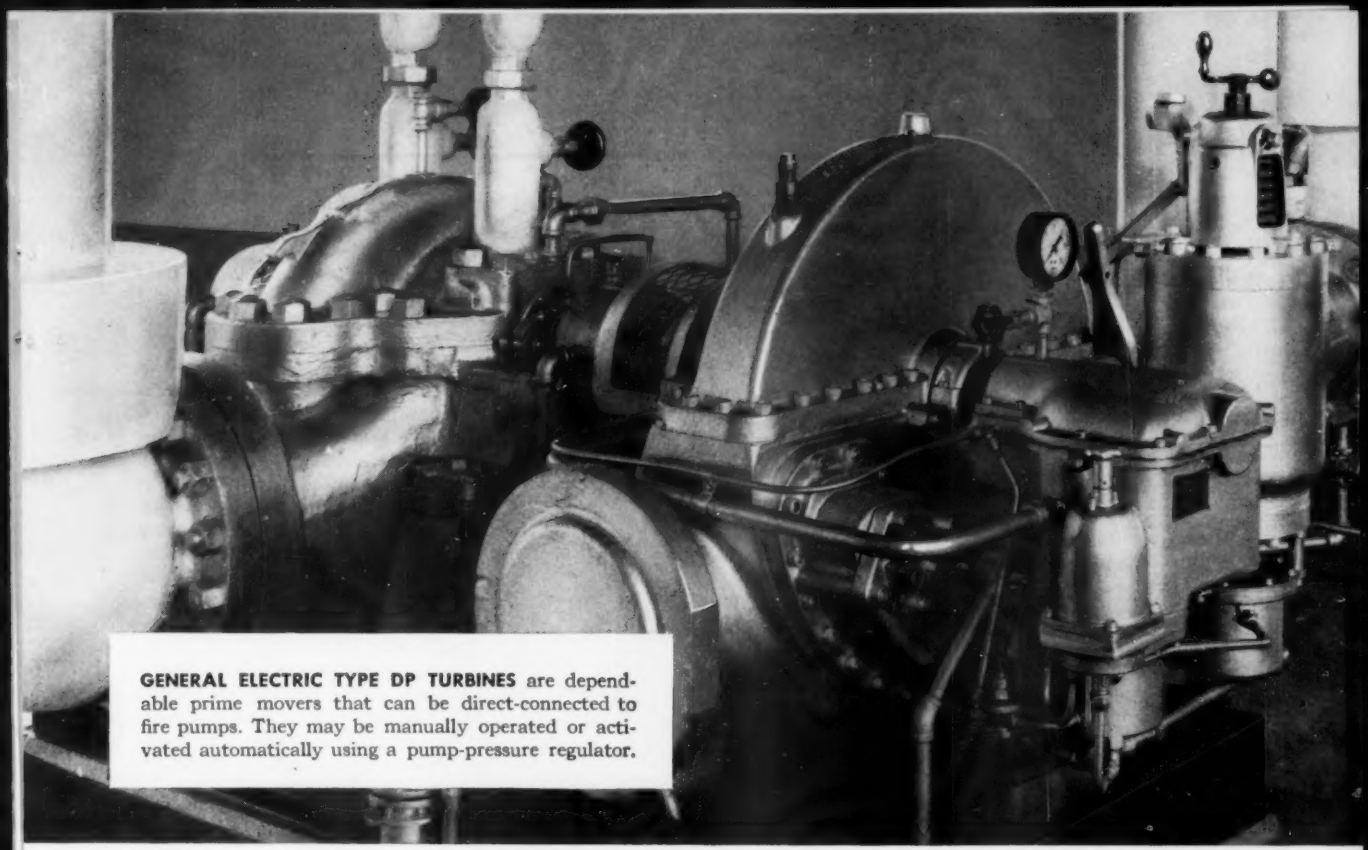
OUR PLANT KEEPS three or four dozen kerosene lamps in case of power failure, blackouts, etc. Storage has been a problem since long periods elapse between their use. Dust and dirt accumulate, then we must clean them before using. This delay doesn't help in a real emergency.

We solved this problem with kraft paper bags of the ordinary grocery-store variety. They are inexpensive and surprisingly durable. We slip a bag upside down, over each lamp from top downward, thus enclosing entire lamp. A 10-pound bag covers the average lamp.

Now we clean a lamp after using. We polish chimney, trim the wick and fill oil reservoir. Bag is placed over lamp before putting away on shelf. When an emergency comes up, lamp is OK.

A PERLINGER *Pittsburgh, Pa.*

(*Continued on page* 130)



GENERAL ELECTRIC TYPE DP TURBINES are dependable prime movers that can be direct-connected to fire pumps. They may be manually operated or activated automatically using a pump-pressure regulator.

Can Turbine Drives Make Your Plant Fire-protection System More Dependable?

For truly comprehensive plant fire protection, pump drives must be ready for immediate and continuous operation. To help meet these requirements, General Electric Type DP turbines are built to fire-protective code* standards. They have simple, rugged construction, are quick starting, and afford dependable operation.

Available at ratings up to 1200 hp for fire-pump service, these standard Type DP turbines have thousands of hours of proved dependability on regular commercial applications. Features that make them especially reliable for fire-pump drives are:

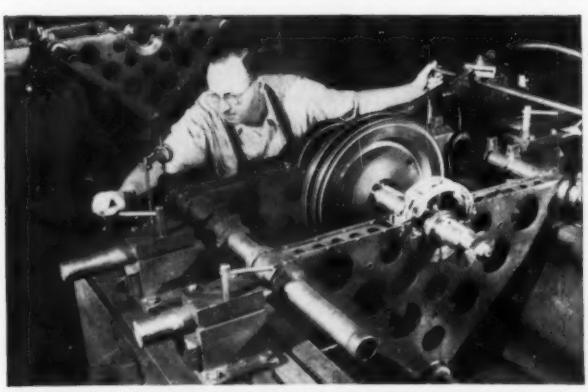
A totally enclosed hydraulic governing system that keeps moving parts to a minimum and eliminates exposed linkage that might wear or corrode.

A compact, pressurized lubrication system that provides more than ample oil, minimizing bearing burnouts during rapid starts, and assuring continuous operation even under adverse conditions.

A sturdy, well-balanced rotor that enables turbines to attain full speed quickly.

Be sure to consider these important features of General Electric turbines for fire-pump drives when planning or reviewing your plant fire-protection system. For additional information, contact the nearest General Electric Apparatus Sales Office or write for GEA-6099, "Mechanical-drive Turbines for Fire Pumps." Address Section 252-67, General Electric Company, Schenectady 5, N. Y.

*National Board of Fire Underwriters' Pamphlet No. 20.



PROPER BALANCE OF TURBINE ROTORS is essential for quick-starting pump applications. Rotors for Type DP turbines are given static and dynamic balancing tests to assure smooth operation throughout the range of turbine speeds.

You can put your confidence in—

GENERAL ELECTRIC

Begins on page 126

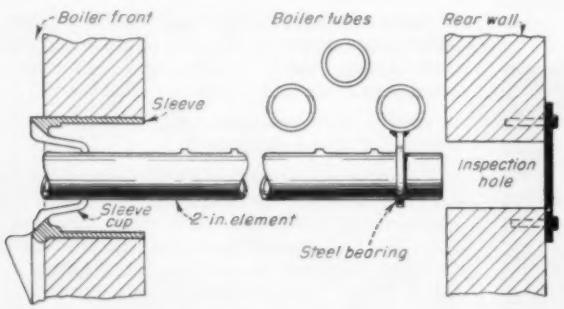
Now, Damaged Galvanizing Is Easy to Repair

SOME MAINTENANCE MEN may not know it, but galvanizing is easy to replace on sheet or other metals when burned off with a welding torch. Or when it is damaged in other ways. I learned this a short time ago and feel the idea should be passed along.

We buy ours in powdered-metal form. Metal is mixed with flux and comes in 2-lb tins. It removes scale from black iron and penetrates rust and grease, then it deposits a coating of zinc alloy.

Powerful flux causes metallic content to coat any metal, including copper, stainless steel, monel, inconel, nickel and chromium. I have had good luck in covering the burned zinc on water tanks when welding fittings to it. Welding was always subject to corrosion on such tanks, but is now protected as it joins with galvanizing on tank and fittings.

F COLE *Philadelphia, Pa.*



We Find Faulty Soot Blowers From Outside

FLUE-GAS TEMPERATURE recorder-chart of our No. 2 boiler was showing higher temperature than No. 1 boiler. Both units had same load of 35,000 lb per hour. Looked as though water and steam would not absorb right amount of heat from gases because outside surfaces of tubes were very dirty and heavily coated with slag and soot. While fireman operated soot blower with steam valve cracked, I stayed in furnace and observed. I found two upper soot-blower elements burned off about 26 in. from inside of front wall.

So two elements were doing no cleaning. As we had had similar troubles, we sent a sample of one burned element to the manufacturer. Burned elements were installed only 2½ years before. Manufacturer told us two years was about normal with gases of our high vanadium and sulfur content.

They recommended long retractable soot-blower units. But those units cost too much for us. Instead, we cut a 3-in. hole next to each soot blower in rear boiler wall, sketch. This hole helps us inspect blower from outside boiler while blower is working.

Fireman looks into the hole once a week while another operates the blower. We had already found a burned element in this way. This 3-in. hole is very useful for checking element's operation, and removing it if damaged.

Since failure is mainly from high temperature, we're planning to cool this section, somehow. Temperatures are about 1920 F where blower elements fail. We now use an additive in fuel oil to minimize corrosion and slag formation.

J R BROWN *Bauta, Cuba*

Close That Paint Can

PACK A PIECE OF RAG in groove of paint can before starting to paint. Then when you finish, withdraw rag. That allows lid to close tight without having to dig out the paint that is dried.

H HOLCOMBE *Los Alamos, N. M.*

Softener Effluents Now Tested Faster

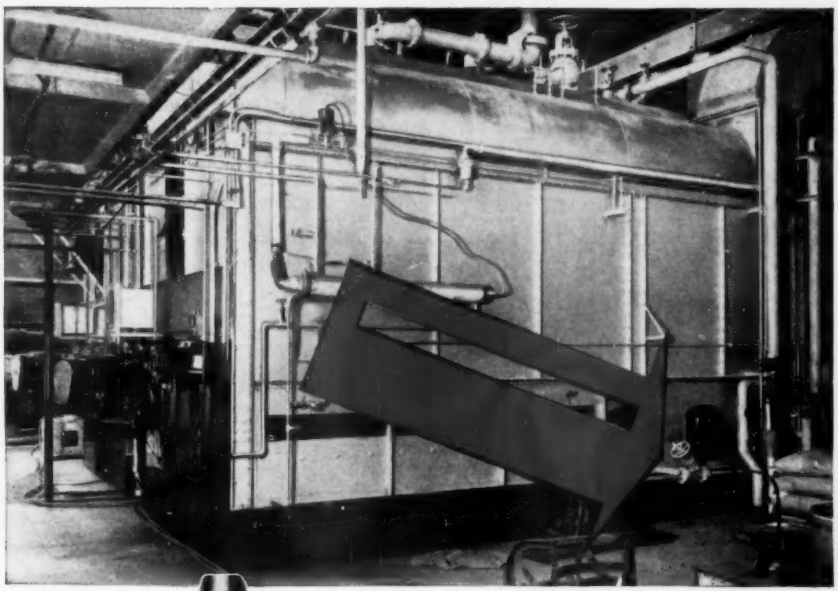
MOST PLANTS use colorimetric red-to-blue color change in testing softener effluents rather than the old style soap-and-shake method. We test softeners each hour and when hardness goes over 20 ppm, softener is cut out, regenerated.

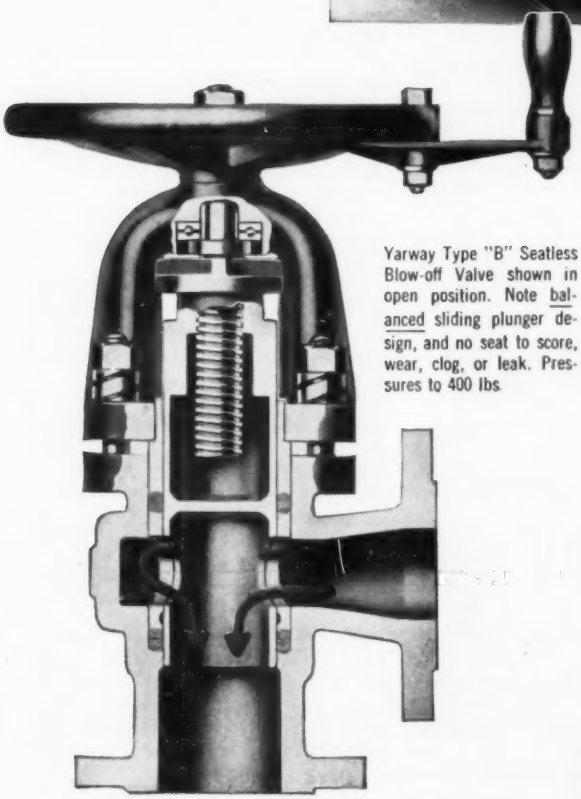
It took a lot of testing time for the night operator to measure out the solutions and to titrate. So we bought 3-oz clear bottles from the drug store. Now the day shift "loads" each one with 1 ml buffer solution, adds 5 drops of indicator, and 1 ml hardness reagent.

Bottles are numbered and etched with a vibro-tool glass marker at the 52-ml test mark, so the 5 drops of indicator won't introduce any error. Operator fills proper bottle to the mark each hour and notes the color: Red means recharge, blue OK. This saves time, eliminates wasted chemicals, prevents expensive test-equipment breakage.

L FITZPATRICK *Jefferson City, Mo.*

THIS ERIE CITY "PACKAGE" INCLUDES A YARWAY SEATLESS





Yarway Type "B" Seatless Blow-off Valve shown in open position. Note balanced sliding plunger design, and no seat to score, wear, clog, or leak. Pressures to 400 lbs.

■ The above installation of two 300 hp. Erie City VL type boilers at a Detroit automotive plant shows Yarway Seatless Blow-off Valves as part of the "package" picture.

Good package-type boilers are *better* when equipped with Yarway Blow-off Valves.

Get the advantages that have made Yarway Blow-off Valves guardians of blow-down lines in more than 15,000 boiler plants. On your package boilers—whatever the make—high grade blow-off valves pay off in dependable, trouble-free service.

Write for Yarway Bulletin B-426.

YARNALL-WARING COMPANY
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YARWAY®

SEATLESS BLOW-OFF VALVES

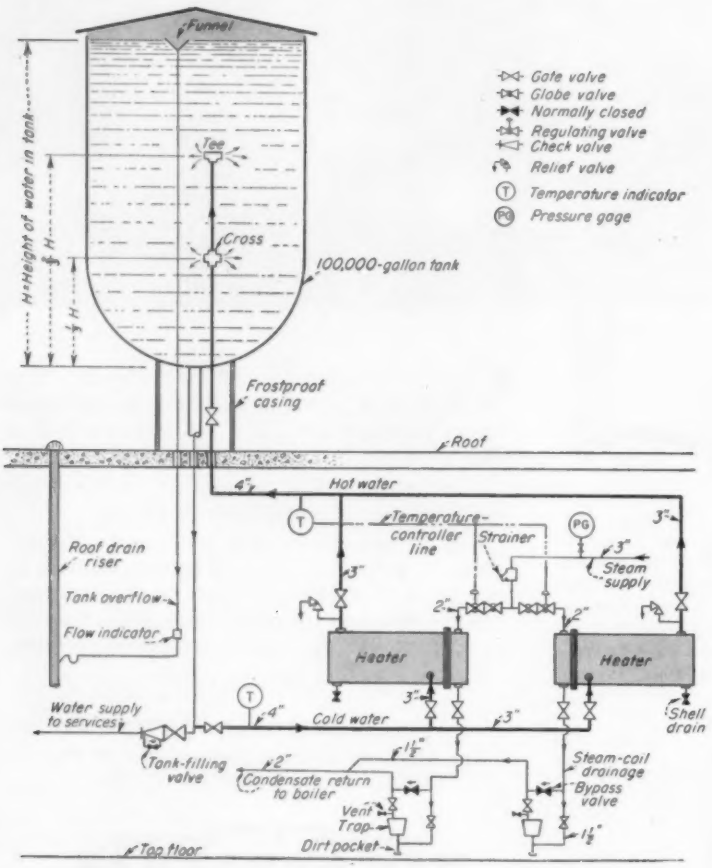
PLANT PROBLEMS... *practical readers give advice*

How Can We Prevent Water Tank From Freezing?

HERE ARE THE FACTS: Our 100,000-gal roof tank of steel for domestic and fire-protection water gave us much trouble during a severe cold spell last winter. Ice blocked some of the tank piping and there were ice formations in the tank itself.

What's best heating system for a tank of this size when outdoor temperature may go as low as –60 F? How should heater be piped for best results? Where is insulation best applied to an outdoor steel tank? What's best insulation?—*NN, Dec Power*

Here Are the Answers



REMOVE HEATER. It is unsuitable for heating water in a tank where the lowest atmospheric temperature is less than 10 F. Another disadvantage of this unit is that temperature of water in the riser cannot be conveniently determined.

Sketch shows a more suitable system for *NN*'s area. This hookup allows continuous circulation of some of the water in the tank. Water leaves the tank through the regular discharge line and passes through one or more heat exchangers where its temperature is increased. Leaving the heater, the water rises through a separate pipe and enters the tank where it is distributed by a cross and tee, as shown in the diagram.

Either shell-and-tube heaters using 15- to 20-psi steam or a cast-iron coal-burning boiler is suitable for heating water taken from the tank. Sketch shows typical hookup for two shell-and-tube heaters. I've assumed enough steam is available from the building's boilers to heat water. When outdoor temperature is higher than –60 F, only one heater need be used.

If the building has no steam, a coal- or oil-fired boiler would be suitable. Boilers of square sectional type are available in rated capacities to about 18,000 square feet equivalent direct radiation.

One major advantage for an existing building is that the square sectional boiler will pass through a comparatively small opening.

Use a 4-in. pipe for water circulation. Note in the sketch that valves are located so there will be water circulation throughout the entire length of the line exposed to freezing temperatures.

Efficient operation of the tank heating system requires a recording thermometer and an indicator graduated to about 20 F. Connect to the cold-water pipe at the point where water temperature is lowest. Keep piping to heaters as short and straight as possible because the head available to produce circulation is slight.

Temperature regulator actuates steam-control valves to regulate steam flow to the water heaters. For accurate control, have the length of capillary tubing between thermal bulb and steam valve less than 25 ft.

Be sure to provide adequate drainage for heater coils, as shown in the sketch. Protect all lines above the roof with a frostproof casing. Locate cross and tee at elevations shown in sketch.

Supply enough heat to keep tank water at 40 F during periods of extreme cold. A circulating pump might prove better than depending on natural circulation of hot water. It would permit reducing size of heat exchangers because the rate of heat transfer would prove to be greater.

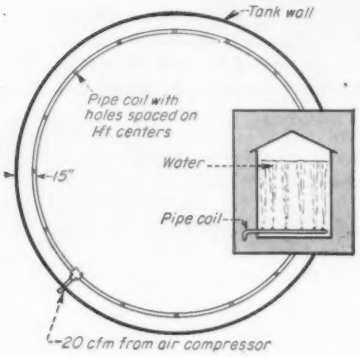
A J BREUGELMANS *New York, N.Y.*

KEEP PRESENT HEATER and install a small thermostatically-controlled pump to circulate water through heater and tank. Set unit so pump starts when water drops below a certain desired temperature. Have it shut off when water reaches correct temperature.

C G HOWARTER *Canton, Ill.*

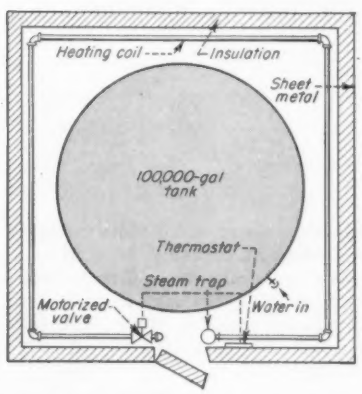
on water-tank freezing and oil-filter hookup

TYLER HICKS *Associate Editor*



COMPRESSED AIR supplied to tank through a circular coil, as in sketch, prevents water freezing in the tank. Use a 2-in. pipe for the coil, drilling holes ⅛ or 3/16 in. diameter at intervals of about one foot. Locate coil about 15 in. from side of tank. If water freezes inside the pipe coil, install another coil to form two concentric air circles. A 20-cfm compressor should have adequate capacity to supply air to the coil.

S H KRONE *Canby, Minn.*

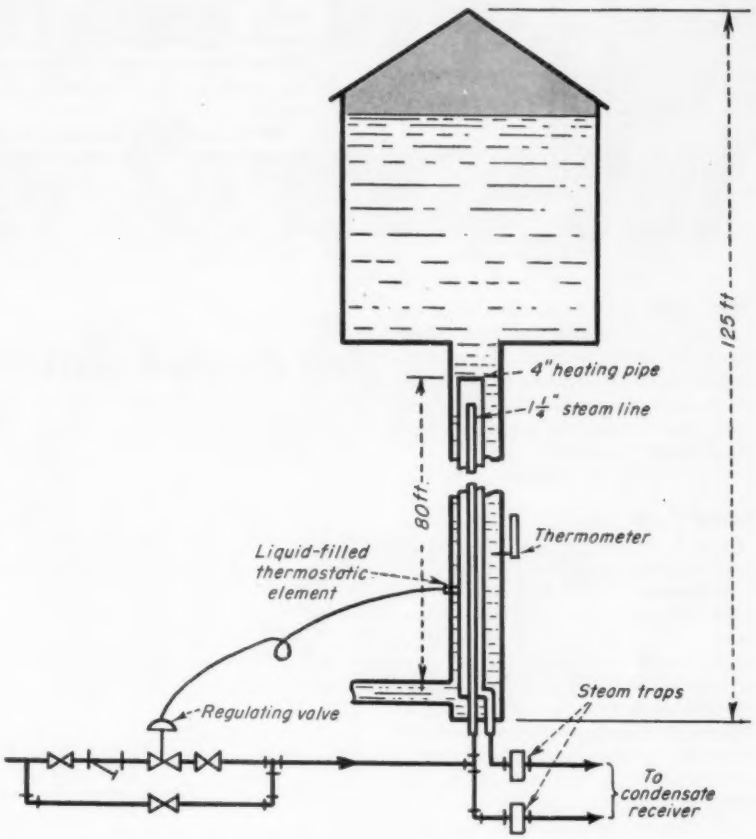


HOUSE THE TANK in a sheet-metal enclosure insulated with rock wool or a similar material. This is probably the best method of protecting the tank from frost. Since the building is only two years old, *NN* can easily justify cost of the housing.

Heat the tank enclosure using radiators, convectors, unit heaters or a simple pipe loop, as in sketch. Provide a thermostat and motorized valve to keep the air temperature in the housing at 40 F, or higher, if desired.

Housing the tank also protects water pipes to and from it. Use corners of the housing for storage space.

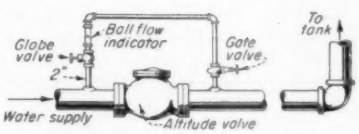
A W LOVITT *S. Burnaby, B. C.*



SKETCH SHOWS heating hookup for our 125,000-gal storage tank. Water in tank gets little use because it is held in reserve for fire protection. Heater requires 2500 to 3400 lb per hr of steam to keep the water at 48 F when the temperature out of doors is 0 F.

A A HUNNEWINKEL *Woodstock, Ill.*

Turn to page 136 for your two new problems



HEAT DEMAND with –50 F outdoor temperature for one day is 1.26 millon Btu per hr. About 1360 lb per hr of 30-psi steam is needed to prevent water from freezing.

Covering tank with 1 in. of insulation reduces heat demand to about half this value. Insulating blankets must be protected with a weatherproof wrapping. *NN* can eliminate need for weatherproofing by using a sprayed-on mastic compound.

Run steam and condensate riser close to standpipe, insulating all three lines with the same blanket or blocks. Trap steam riser at heel. Two traps on the condensate return line may prove to be helpful.

Keeping water in motion with a bypass around the altitude valve helps prevent freezing.

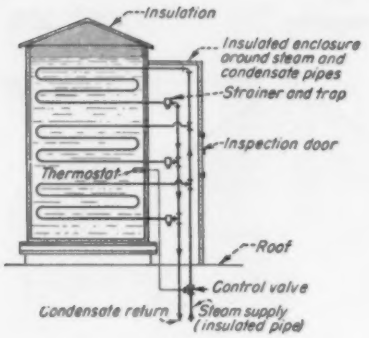
In the hookup that is sketched, gate valve is kept wide open and flow regulated with the globe valve. Ball flow indicator shows how much water is bypassing altitude valve. The hookup shown in this diagram is used where the tank is piped to ride on the line.

K A TRAUB *Detroit, Mich.*

(*Continued on page* 134)

More PLANT PROBLEMS

Begins on page 132



TALL TANK may need more than one steam coil for heating the water. Hookup in the sketch is good. Fit a steam control valve to shut off steam supply when water reaches the desired temperature. Insulate tank to prevent freezing when steam is shut off.

H. B. WAYNE *Brooklyn, N. Y.*

DRAIN TANK whenever a temperature of –20 F, or less, is expected. But before draining, check your fire insurance requirements. They may prevent you from draining any or all water from tank. We've operated our 500,000-gal outdoor tank successfully without heaters during –10 F weather by limiting the amount of water stored in it to 150,000 gal. We continuously circulate water through an oversize standpipe and a special riser on tank top during the periods of extreme cold.

We figure the additional pumping costs are far less than the cost of steam for heaters. We find it wasteful to heat tank water to a temperature higher than 38 F. Where you must use insulation, hair felt is excellent. It should have a wrap of tarred roofing felt and a final coat of asphalt-base aluminum paint.

L. W FITZPATRICK *Jefferson City, Mo.*

TANK DIMENSIONS are about 25-ft diameter and 33-ft height. If *NN's* tank is exposed on all sides and on top and bottom, total area open to contact with atmospheric air is 3570 sq ft. With a water temperature of 40 F, heat loss is 1.92 million Btu per hr when outdoor temperature is –60 F.

There are three solutions to *NN's* problem: (1) Maintain sufficient water flow to prevent temperature falling below 40 F. (2) Heat water with a steam coil in the tank or by recirculating through building water heater. (3) Insulate tank, piping to reduce heat loss.

With water leaving the main at 50 F, a 24,000-gph flow is required to main-

(*Continued on page* 208)

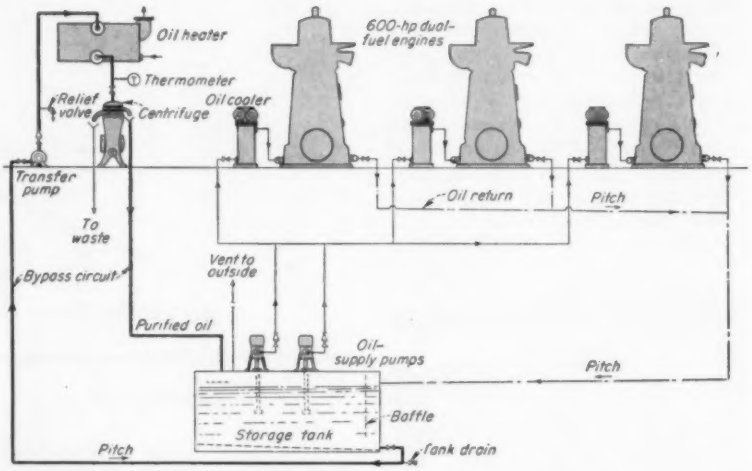
Which Is Best Oil-Filter Hookup?

HERE ARE THE FACTS: We're planning to install three 600-hp 4-cycle supercharged dual-fuel diesels in our municipal power plant. Engine manufacturer has given us our choice of lube-oil filter type and hookup. We'd like help from *Power* readers on choosing a system.

Which hookup is best for this kind of engine—bypass or full-flow? What pressure drop can we expect across the filter in each hookup? Can the same type of filter be used for both systems?

How does time between cleanings vary, assuming engine produces the same amount of dirt? Will savings in first cost for one kind of installation be offset by higher costs in other?—*AF, Dec Power*

Here Are the Answers



BYPASS SYSTEM in which about 10% of the oil circulated is bypassed to the treating equipment is best for *AF's* plant. This hookup keeps total quantity of impurities below danger level without requiring large treatment equipment and investment.

Cartridge-type filters are suitable for bypass systems. Centrifuges may also be used. Sketch shows one way to pipe a system for continuous centrifuging of a portion of the oil. An oil heater is suggested ahead of centrifuge for easier separation of impurities from oil.

My experience shows that the entire tank contents should be purified about three times each day. After 200-hr service, it is wise to transfer the oil in the storage tank to a settling tank for precipitation of colloidal or soluble sludges. These settle out at temperatures below 100 F. A fuller's-earth oil purifier can be substituted for settling.

A J BREUGELMANS *New York, N. Y.*

CENTRIFUGES give better results than filters and require little maintenance. Their cost, however, is usually higher. Installing centrifuges for lube oil in our plant cut lube-oil costs, eliminated gummed rings, carbonized pistons and valves. We now inspect pistons and liners at regular intervals because we have no forced shutdowns.

JOHN GORRIE *Euclid, Ohio*

CHOOSE DUAL ELEMENTS when picking a filter. This insures adequate protection for the engine and reduces cleaning to a routine job. Log records are a big help in showing when a filter must be cleaned.

Pipe the filters carefully so that they are easy to isolate for cleaning.

C G HOWARTER *Canton, Ill.*

(*Continued on page* 136)

Wherever Drip, Splash or Squeeze-out Is a Problem

Use SUNTAC

Suntac Oils stay put, leave no gummy residue. They are ideal for lubricating gears, sprockets, chains, cables, couplings, linkages and bearings where throw-off must be avoided. Call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. P-3

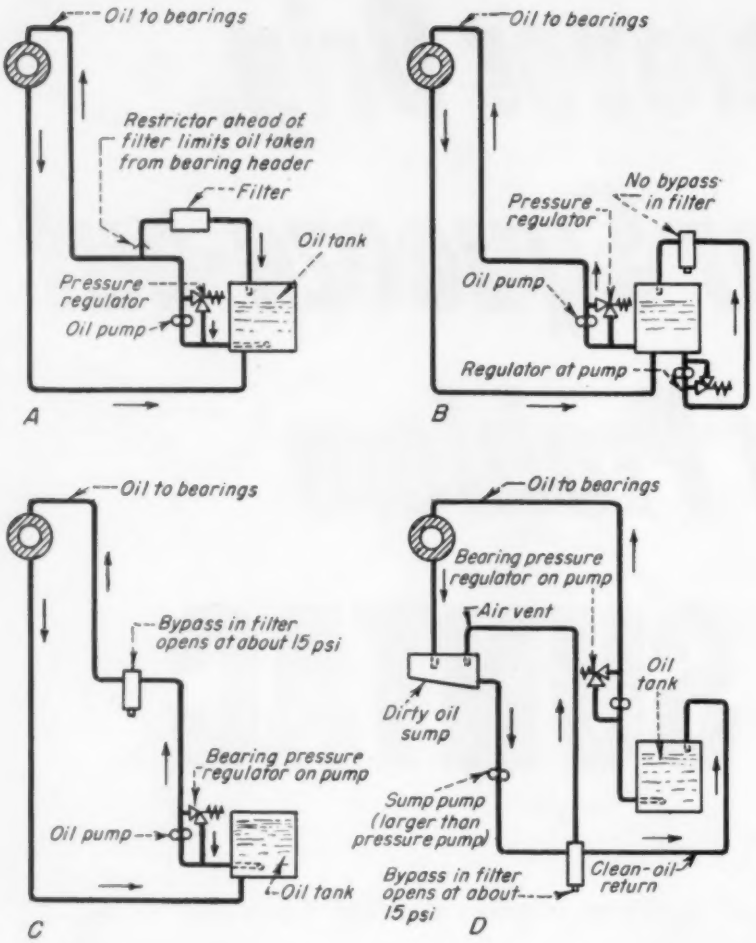
INDUSTRIAL PRODUCTS DEPARTMENT
SUN OIL COMPANY

SUNOCO®

PHILADELPHIA 3, PA. • SUN OIL COMPANY LTD., TORONTO & MONTREAL

More PLANT PROBLEMS

Begins on page 132



FULL-FLOW SYSTEM passes all oil through the filter while the bypass arrangement allows only a portion of the oil to go to the filter. Bypass or shunt system often is automatic and usually has but one oil pump. Sketch *A* shows a typical hookup for a system of this type.

Hookup in *B* has two oil pumps. Like *A*, it has the disadvantage that contaminated oil can reach engine bearings.

Typical full-flow systems are shown in *C* and *D*. That in *C* is simple and offers maximum protection from dirty oil. With two pumps and sump *D*, large engines secure best protection for bearings and other lubricated parts.

Centrifuges may also be used for continuous purification of lube oil. *AF* will have least trouble with a centrifuge, but he'll find the first cost a bit higher than for standard filters.

Remember that the pressure drop in a shunt or bypass system is less than it is in the full-flow system.

H B WAYNE *Brooklyn, N. Y.*

SEPARATE PUMP to take oil from engine sump and deliver it to a filter gives us best results when the oil has more than the usual tendency to become contaminated by combustion products, dirt, metal, water and fuel oil. Pump returns oil to engine sump after it passes through the filter. This setup handles any reasonable oil flow.

Most filter manufacturers choose as great a pressure drop as possible to insure longer life for filter cartridges. This varies from about 12 to 26 psi. Drop through new filter may be as low as 4 psi.

Fit gages on filter inlet and outlet so you can determine cartridge condition. Mark upper-limit pressure points with red ink so operator sees at a glance condition of the filter. Another trick is to install a pressure-actuated switch that warns operator of a large pressure drop across the filter. Newer engines are protected by high- and low-pressure alarms.

While operating on gas, *AF* will find that filter cartridge life is longer because the fuel-oil leakage is negligible.

L W FITZPATRICK *Jefferson City, Mo.*

YOUR NEW PROBLEMS FOR MARCH

1 Should We Ground Plant Neutrals?

We're expanding our industrial plant's electrical system and would like your readers' opinions on grounding of neutrals.

Should neutrals on transformers and generators be grounded? Why? What are the advantages? Many plants operate for years without grounding and never seem to get into trouble.

Where and at what voltage levels should we ground? Can any parts of system be left without grounds? What kinds of overcurrent devices are needed? How can we protect motors?

When should we consider resistance grounding? What is the best detector for an ungrounded system?—SJ

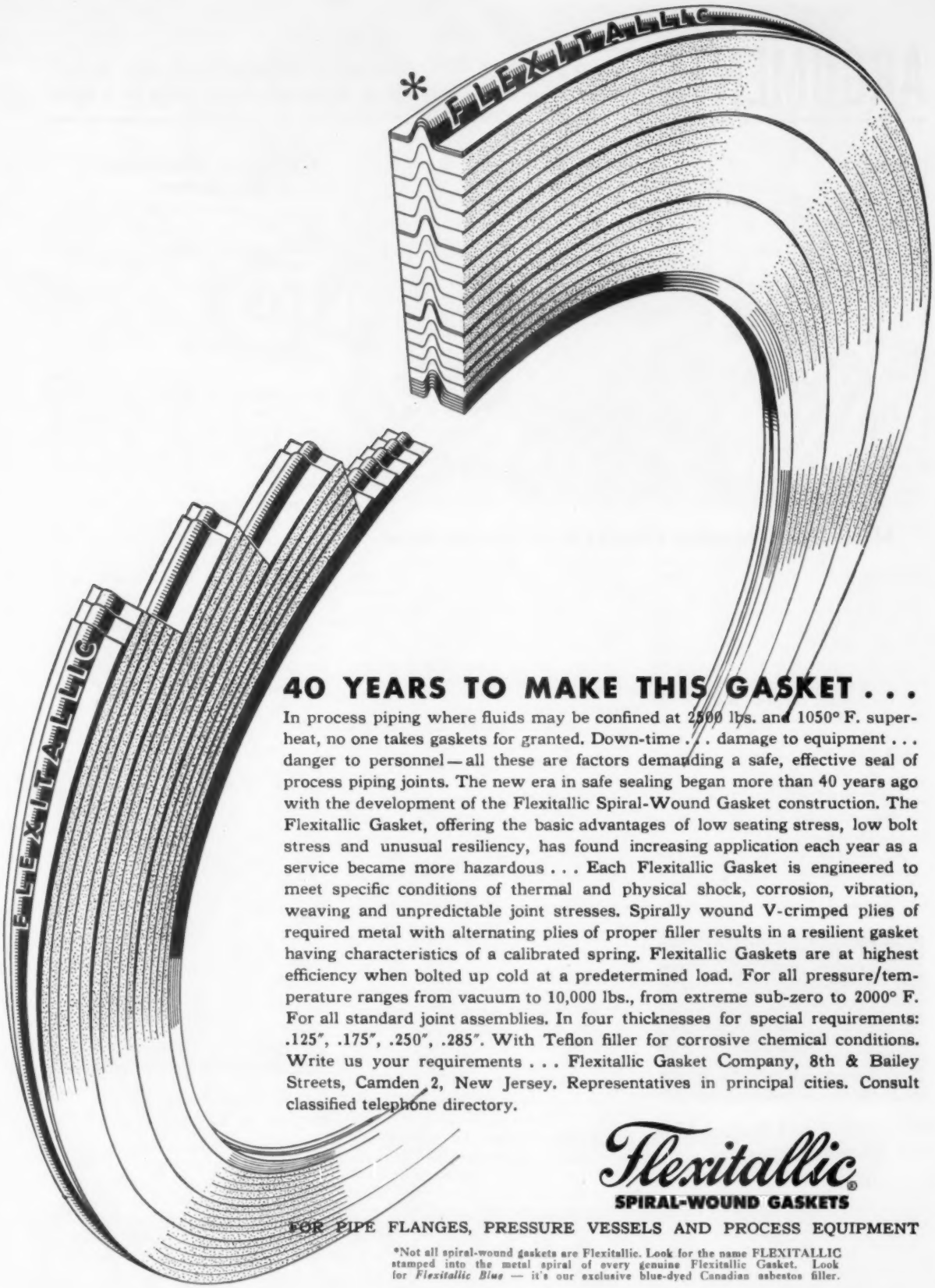
2 Will an Accumulator Help This Plant?

Our hosiery mill produces many types of stockings in steam-using machines. Steam demand of these machines is high during starting period, then tapers off.

Our big problem in production results from the high demand of individual machines and the difficulty of predicting when a given machine will start. If more than one unit start at the same time, steam demand is many times that of normal.

Will an accumulator between our boilers and manufacturing units cure this condition? How should it be piped? Is there any approximate relation between boiler capacity, system demand and accumulator size?—FG

Will you help readers who sent problems? Extra pay for photos, sketches.



40 YEARS TO MAKE THIS GASKET . . .

In process piping where fluids may be confined at 2500 lbs. and 1050° F. superheat, no one takes gaskets for granted. Down-time . . . damage to equipment . . . danger to personnel—all these are factors demanding a safe, effective seal of process piping joints. The new era in safe sealing began more than 40 years ago with the development of the Flexitallic Spiral-Wound Gasket construction. The Flexitallic Gasket, offering the basic advantages of low seating stress, low bolt stress and unusual resiliency, has found increasing application each year as a service became more hazardous . . . Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

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SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

ARGUMENTS

Got a problem? Want to argue with the editors? Like to comment on items of interest to fellow readers? Send in a letter

Mind Now! Marmy Chalks Out Steam Flow

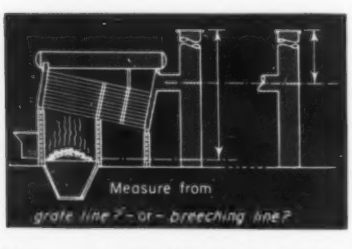
MARMADUKE SURFACEBLOW, the consulting engineer, had better change his brand of bottled inspiration. After reading "Marmy's Loose Screw" in January POWER, I want to know how a condensing turbine can use less steam when the vacuum drops. He says vacuum dropped and the boilers popped. Well, maybe they did. I won't argue with a guy like Surfaceblow. But I'd still like to see it.

J B TURNER *Toronto, Ontario*

MARMADUKE'S COMMENTS: (*delivered during a highly technical discussion at the Bent Propeller Bar and illustrated by a tablecloth drawing*):

"BILGEWATER ON POPPING SAFETY VALVES! Of course, climbing backpressure won't change the steam consumption in a turbine. Like this chart shows, steam flow through a nozzle or a turbine doesn't change until backpressure comes up to about half of inlet pressure. Now that's the last time I want to hear anything about *that!*"

EDITOR'S NOTE: *After carefully studying Marmaduke's comments, above, with a magnifying glass and checking up on the weight of steam flow through a nozzle, we deduce that he not only agrees with Turner but also goes on to explain why Turner is correct. True, it would be against Marmy's principles to admit it by saying so. We, however, want to thank Turner for being on his toes.*



Where Is Right Datum Line For Chimney Height?

I WAS AMAZED at the variety of answers to the question of chimney height presented in June "Plant Problems."

Since the wrong approach to this important problem has appeared in so many publications in the last 20 years, let's straighten out the matter.

The bone of my contention is the proper datum point for calculating stack height. I believe the required height should be measured above that point in gas travel where the absolute pressure is least. In the example presented on page 136, June POWER, the height of 158 ft (if otherwise correct) should be above the connection of breeching to chimney rather than above the grate line.

This is important because on a 20,000-lb-per-hr boiler the entrance of breeching to chimney may be as much as 15 ft or more (depending on design) above the grate line. In the case illustrated, the error might be 10% or more.

F A BERGEY *Detroit, Mich.*

EDITOR'S NOTE: *What experience have you readers had? Is Bergey's contention right? Send in your comments.*

Phooey on Murdered Feed Regulators!

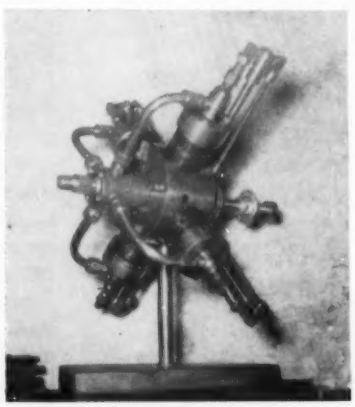
IF JOHN GORRIE'S article, "Don't Murder Your Feed Regulator," December POWER, was just for laughs, it would compare favorably with *Out Our Way*. If any type of elucidation was intended, he was at least ten years too late—maybe that "ex" before "insurance inspector" covers more years than I've been working.

In any event, operation and instruction manuals have been made available to me on all jobs, and the best operation of the plant has always been the prime consideration.

Perhaps I've been exceptionally lucky with respect to fellow workers. In states where there are no license laws, our union assumes the responsibility for certifying operators, so it would be difficult to find situations such as he described. I believe he was talking about the "good old days."

One other issue I should like to take with friend Gorrie is that a bellows may suffer fatigue from strains, but it was certainly crystalline at the time it was installed in the plant.

H HOLCOMBE *Los Alamos, N. M.*



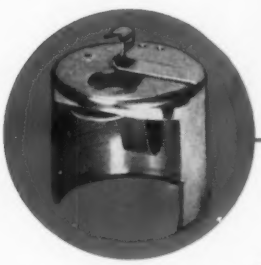
Could You Build This Engine in Larger Sizes?

ABOVE PHOTO shows a single-acting 4-cylinder radial steam engine that I built from scrap parts. It runs very well in this small size, and would be ideal with superheated steam and high speed.

Can any reader tell me why this type engine is not built in sizes as large as the diesel engines are now?

T DEROSA *South Vineland, N. J.*

Here's a *Real* STEAM TRAP PACKAGE

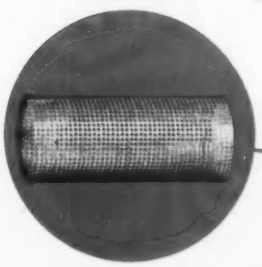


WANT FAST HEAT-UP OF OFF-AND-ON PIPE COILS, HEADERS, UNIT HEATERS, ETC.?

Speed heat-up with Armstrong thermic bucket traps. When steam is first turned on, air is pushed out the large thermic vent—fast! As soon as steam reaches the trap a thermic strip closes the vent, then the bucket functions as a regular bucket. Traps with thermic vent buckets discharge air 50 to 100 times faster than other traps.

NEED A CHECK VALVE AHEAD OF TRAP?

Just specify Armstrong with internal check valve. No check valve installation labor or fittings needed. Spring loaded action and vertical position minimize danger of dirt holding valve open. The Armstrong internal check valve is top quality—long lasting.



NEED A STRAINER AHEAD OF TRAP?

Save money with Armstrong built-in strainer traps. They cost less than a separate trap and strainer and save installation time and money. Stainless steel screen lasts a long time.

Get the full facts about all Armstrong traps. Send today for free Catalog J, The Armstrong Steam Trap Book.

ARMSTRONG MACHINE WORKS
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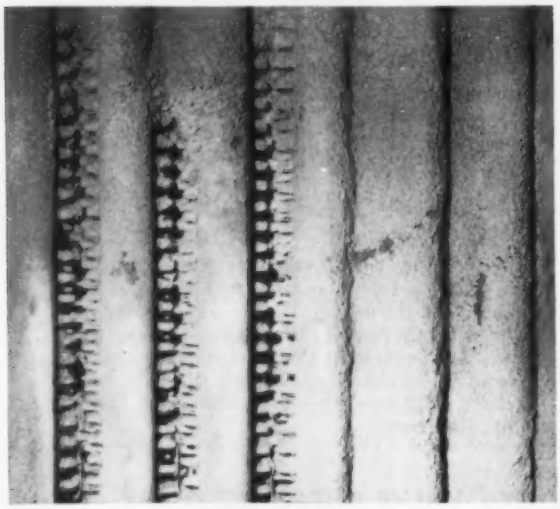
ARMSTRONG STEAM TRAPS

1 Remove old material from stud-tube waterwalls with air hammers. Loosen ore without harming the tubes or studs

2 Adjust air and material mixture so thin slurry sprays evenly over tubes and anchors in studs on side of tubes



3 Partly finished wall, *at left*, shows studs coated but not packed solid. Finished tubes, *at right*, are coated evenly

4 Shave excess material off bare-face tubes (on front wall) before it hardens. Side wall is finished, ready to cure

HOW TO Spray Chrome-Base Castable Refractory

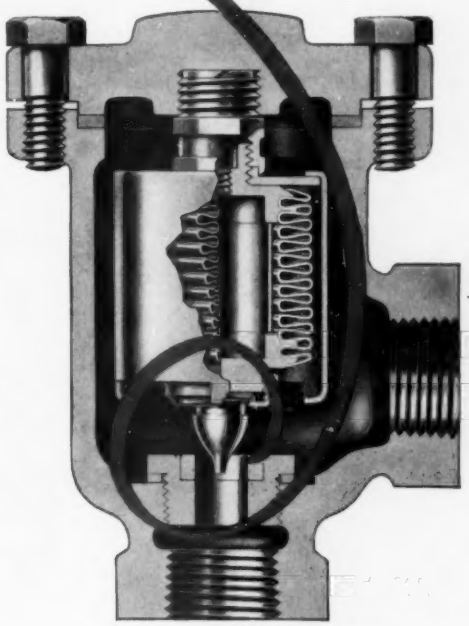
► STUD-TUBE BOILER WALLS shown are coated manually with chrome-ore or sprayed with chrome-base castable refractory as in photos. A 4-man crew on a large job should spray from 7 to 10 tons of this material in 8 hours. Because it takes same time to tear out any kind of old material on these jobs, saving on down time depends mostly on how you apply new material.

Chrome-base material shown is usually cured by spraying water onto the exposed surface 4 hours after material has been applied. Then again each succeeding 4 hours until wetted 3 times. That makes 24 hours of curing. In emergency, unit may be put into service 12 hours after coating, but that reduces refractory life.

Plants that don't have equipment shown usually have some major concrete-contractor in a large city do the work. About 30-psi air is needed. *Courtesy, Botfield Refractories Co*

EQUIPMENT needed is air compressor, mixing unit and hose

Same size seat and head for all pressures to 300 psi!



Is this your steam TRAPPING PROBLEM...

Changing seats and heads for varying loads or pressures to 300 psi?

HERE'S HOW to select the right trap!

First thing to do is to define exactly what you expect the trap to do—and then select 1 of the 5 *different* types best suited for the job on hand. If you need a trap with *one or all* of the following characteristics, then the Sarco Thermostatic Trap is your best bet.

1. No changing of seats and heads for varying loads or pressures to 300 psi . . . the thermostatic element is *self-adjusting*.
2. High capacity with small size (¾" trap fits palm of hand) . . . offers greatest capacity per dollar cost.
3. Large capacity air venting *regardless of steam pressure*; also freeze-proof, trap is wide open when cold.
4. Easy maintenance: bellows is only working part . . . can be removed, inspected and replaced in a few minutes.

HELPFUL BULLETIN: Send for Bulletin 145, "Selecting The Right TYPE Steam Trap." Gives characteristics of each type of trap and shows which type to use on various installations.

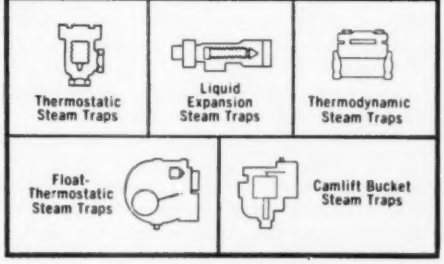
ENGINEERING SERVICE: Because only Sarco makes all five types of traps, Sarco can give you impartial advice on your trapping problems. Check your local Sarco sales representative next time a problem arises, or write Sarco Company, Inc., Empire State Building, New York 1, N. Y.

SARCO BALANCED PRESSURE THERMOSTATIC STEAM TRAP

Sizes ⅜" to 2", pressures to 300 psi. Write today for Bulletin 250.

Only Sarco Makes All 5 Types

. . . that's why Sarco can give impartial advice on trap selection

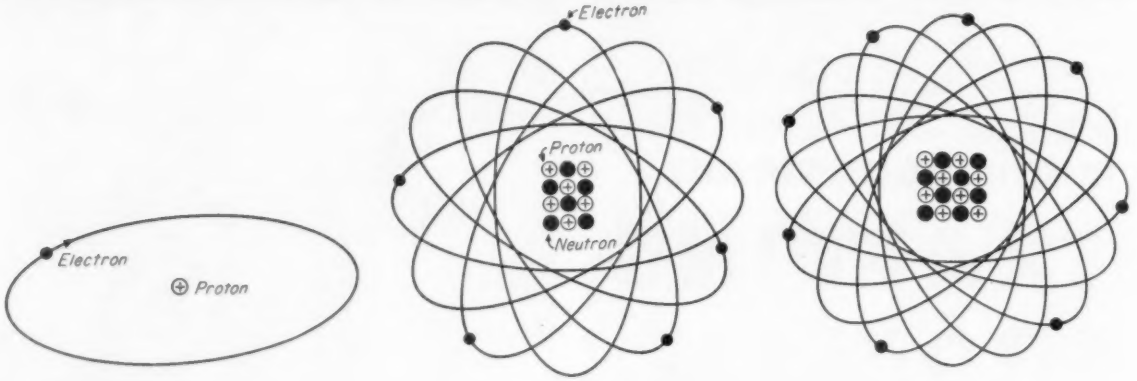


SARCO *improves product quality and output*

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



Combustion Facts-1: ATOMS

► WRITTEN IN PLAIN LANGUAGE, this new series will deal with the basic chemistry of combustion. Some engineers will find these articles handy for study, others for a quick review.

Next year, we may follow up this series with another dealing with the practical side of combustion—actual fuel burning in actual furnaces.

Atoms and Elements. The smallest piece of an element *that remains the same element* is called an atom. Lightest of the 92 natural elements is hydrogen. If you take the weight of this H atom as the unit of atomic weight, you get the table below for the atoms of interest in combustion problems.

Inside Atoms. Unless you plan to run an atomic (atom-splitting) power plant, you need never look inside the atom to see how it is built. But most engineers like to have some idea of what they are dealing with, so here is our quick and simple picture of the inside of atoms.

Every atom is like our solar system. The central sun is the "nucleus." Around it the electron "planets" whirl in their orbits at terrific rpm.

More than 99.9% of the weight of any atom is in the nucleus. This nucleus contains two kinds of particles—protons and neutrons, each weighing one atomic unit, approximately.

Each proton carries one plus electrical charge. A neutron, as its name suggests, carries no charge.

For each plus-charged proton in the nucleus there is one electron plant with an equal and balancing minus-charge. The attractive force of these opposite charges holds the electron in its orbit. Since the opposite charges cancel each other, the atom as a whole is electrically neutral.

Compared with the nucleus the weight of the electrons is negligible. So you can get the approximate atomic weight of an atom by merely counting the number of particles (that is, the number of the protons and neutrons) in the nucleus.

Above are schematic drawings of the atoms of typical combustion elements. Hydrogen, with only one proton for a nucleus and one electron planet, is the lightest and simplest atom.

All other atoms have at least one neutron for each proton. The heavy atoms, such as uranium, have far more neutrons than protons.

Carbon, nitrogen and oxygen have protons and neutrons in equal parts—six and six for carbon, seven and seven for nitrogen, eight and eight for oxygen. Thus their atomic weights are twelve, fourteen and sixteen, respectively.

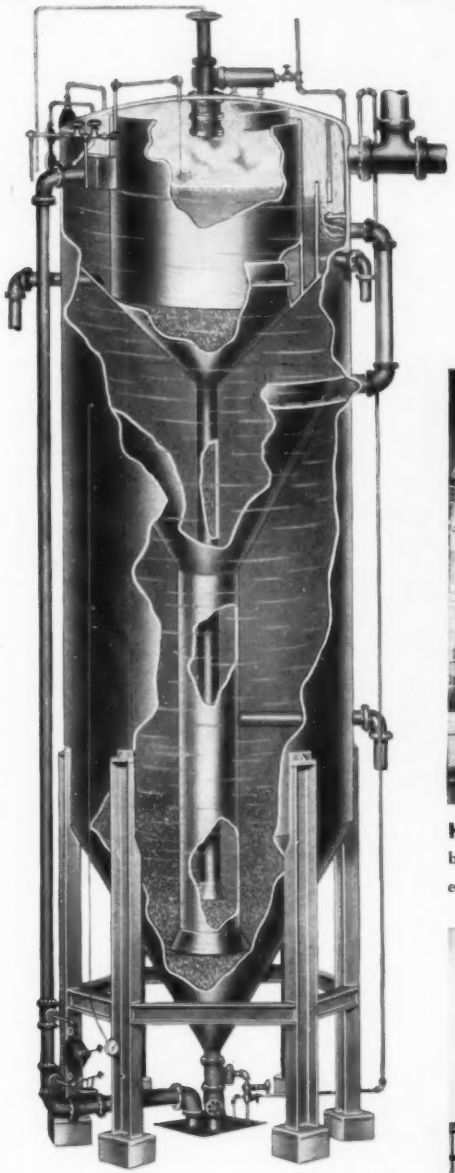
I have laid out the protons and neutrons in straight rows for easy counting, but don't take these idealized diagrams too literally. Also, the nucleus is shown much too big. In true scale a nucleus is as much smaller than an atom as an apple is smaller than a football stadium. Atoms are mostly empty space. Even solid steel is "full of holes" and not much else. That's why a neutron can fly through steel sheet.

These Atoms Are Important in Combustion

Element	*Symbol*	*Atomic weight*	*Ordinary form*
Hydrogen	H	1	Lightest gas
Carbon	C	12	Black solid
Nitrogen	N	14	Gas slightly lighter than air
Oxygen	O	16	Gas somewhat heavier than air
Sulfur	S	32	Yellow solid

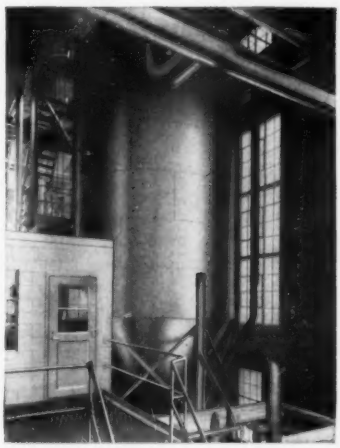
In Hot Process Softening, too

BELCO Builds a Complete Line-

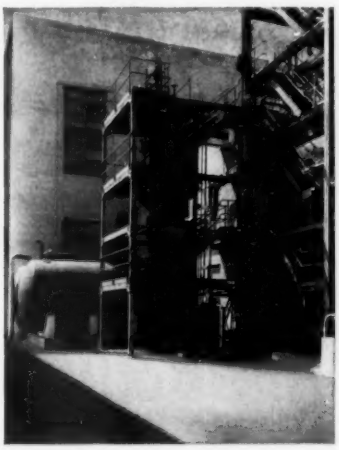


Illustrated literature "Belco In Pictures" is available on request. Write for copy, today.

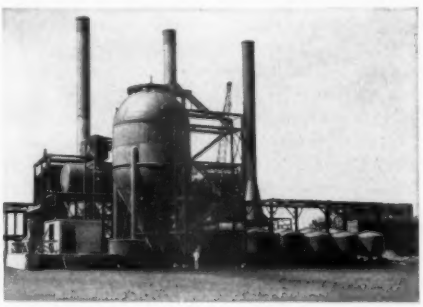
Belco-designed equipment provides high operating efficiency at low operating costs. Many of the country's largest industries rely on Belco for their water conditioning equipment. For example, Belco has built the largest fully automatic demineralization plant in the world and is currently furnishing one of the largest hot lime zeolite installations. A consultation with Belco could lead to lower operating costs for you, too. Write or call for technical assistance at any time.



HOT LIME SODA — Installation in boiler house at large eastern oil refinery. Has capacity of 200,000 lbs/hr.



HOT LIME SODA — Installation in large southwestern utility. One of three units with 90,000 lbs/hr total capacity.



HOT LIME BELCOLITE — Installation at large southern chemical company. Capacity 600,000 lbs/hr. This plant embodies "thoroughfare" operation of separate deaerator and hot process tank. The large hot process tank was designed, built and erected by Belco under its contract with customer.

Belco

Processes for Removal of Water Impurities

Boiler Feedwater Heaters • Water Softeners • Filters • Clarators
Demineralizers • Automatic Process Control Panels

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"Here," I said, "Have a cup of coffee and let's talk it over."

The Boiling Coffee Pot

► THERE WAS A LOT of excitement around the POWER office one day last month. *The Marmaduke Story* had just come off the press and we all crowded around publisher Shelton Fisher to get a glimpse of the book. Sure enough, there was the foxy old consulting engineer's picture staring up at us from the shiny red cover. And inside we found a well-illustrated collection of his better stories. Before long we learned that these books are for sale at $1 a copy.

"What's it all about?" I asked Shelton.

"Well," he answered, "subscribers have been writing in asking for a Marmy book to give to friends or to keep for themselves. Then again, manufacturers have been asking for a collection of these stories to present to their customers and prospects as a 'good will' builder. So here's the first 6000 copies."

"Just wait 'til the old boy sees this," I exclaimed enthusiastically. "I'll take this one over and get his autograph.

Half an hour later I was climbing the rickety old stairs leading to the dingy office over O'Houlihan's Machine Shop & Engine Works. I found our hero in a horizontal position on his setee, taking equal strains on all parts of his 6 foot 4 inch frame. His snoring sounded like a ship's reduction gears that had been stripped completely.

"Mr Surfaceblow," I yelled as loudly as I could, "You are famous. Wake up."

The snoring stopped abruptly. Marmy clenched his enormous fists and let out one terrific yawn, then poked the wall so hard with a haymaker that a chunk of plaster fell out above his head. Blinking his eyes, he roared, "Heave me a line, mate, I'm coming aboard." He blinked again and sat up suddenly, surprised to find he had a visitor.

"Just autograph this," I said, handing him a pen and holding the book before him.

"BILGEWATER ON AUTOGRAPHING BOOKS —and on book authors, too," yelled the cantankerous old mariner who had probably sailed aboard more ships and operated in more stationary plants than any dozen engineers put together. "I'll tell you about the time I got an insulation order autographed by the toughest prospect in the middle west."

Slightly dazed by this sudden switch, I sat down on the setee and Marmy anchored himself in his swivel chair.

"Back in 1892," he bellowed, propping his huge feet on his rolltop desk and clamping his old gray bowler down over his snow white crop of seaweed hair, "I signed on the river steamboat *J M White* at New Orleans for a trip to St. Louis. She was owned by the New Orleans & St Louis Packet Co and was the proudest steamboat on the river.

"The *White* was a giant of 2027 tons and had a battery of ten steel boilers of the conventional flue type. She had two 43-inch diameter single-cylinder engines with an 11-foot stroke. The two engines developed 2800 hp when turning her 44-ft side paddle-wheels. Under favorable conditions, she often chalked up 20 knots.

"She carried passengers and freight. A passenger by the name of Charles Whitlock made me a proposition when we tied up near the Eads Bridge at St Louis that trip. He had started manufacturing asbestos insulation a few years before and wanted me to try my luck calling on prospects around St Louis.

"Whitlock offered me a good deal because he thought my steam engineering experience would help me talk turkey to older prospects who didn't believe in insulating. In those days it was common to build a plant and leave the steam lines run bare, even for long distances outside.

"A few days after paying off the boat, I was ready to tackle my first prospect. It was the Excelsior Tool & Foundry Co across the river in East St Louis, Ill. Whitlock told me that he had called on the president, Mike Phillipe, two or three times, but the old boy wouldn't sign on the dotted line.

"This firm had a group of six large buildings. The boiler house was in the center and had bare steam lines running to the large machine shop, erecting building, foundry and to the office and pattern shop.

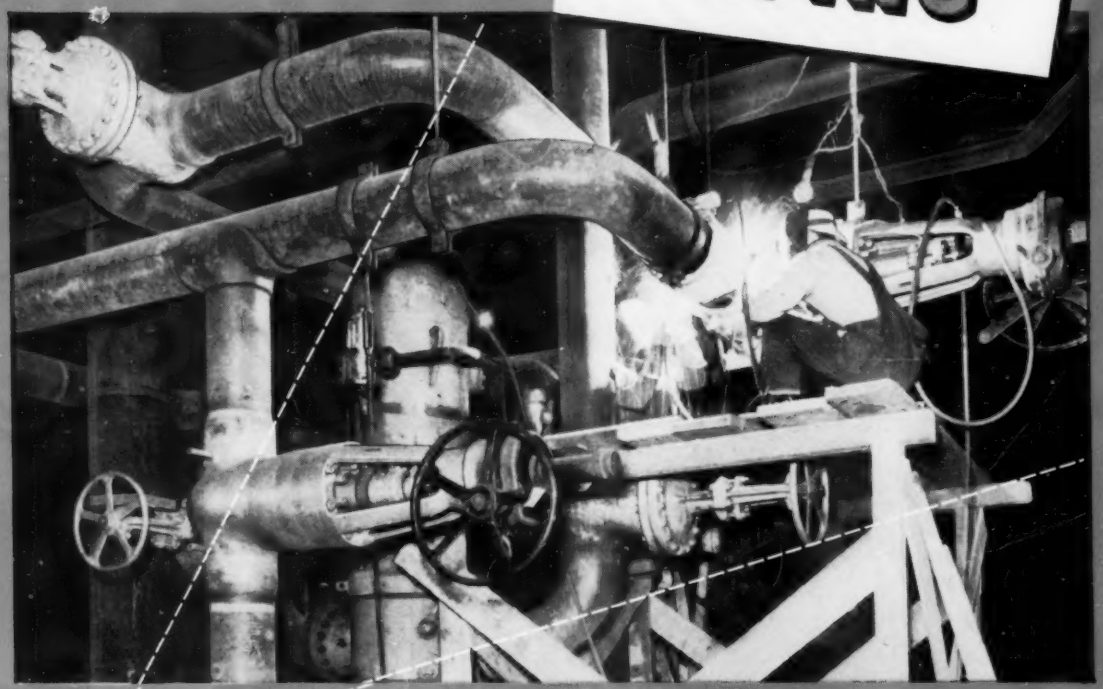
"All buildings had large radiators along the walls, with two-inch lines connecting them. And there wasn't a piece of insulation on any of the 4,000 feet of piping. Whitlock said he had spent an hour with the president last call he made. He did some fancy calculating and showed him how he could save about a third of his fuel costs by insulating those lines. The president listened and then told him that those lines were bare when his father built the place twenty years before, and he saw no reason to insulate them now.

"'Suppose you try your luck on him first,' suggested Whitlock. 'I don't expect you to sell him, but after tackling a guy like that, I'm sure you won't be discouraged, regardless of who you run up against.'

(*Continued on page* 210)

THERE IS

MUCH MORE TO MIDWEST PIPING



THAN MEETS THE EYE

Here you see carefully qualified Midwest welders erecting the boiler feed piping in a new public utility steam-electric generating station. What you don't see are the many other highly skilled men who contribute to the high quality of Midwest Piping.

First, there are the expert piping engineers who prepare the job for fabrication. They simplify the field work and make sure the difficult operations are done in the shop. And they often make suggestions that improve the design and reduce the cost of the piping.

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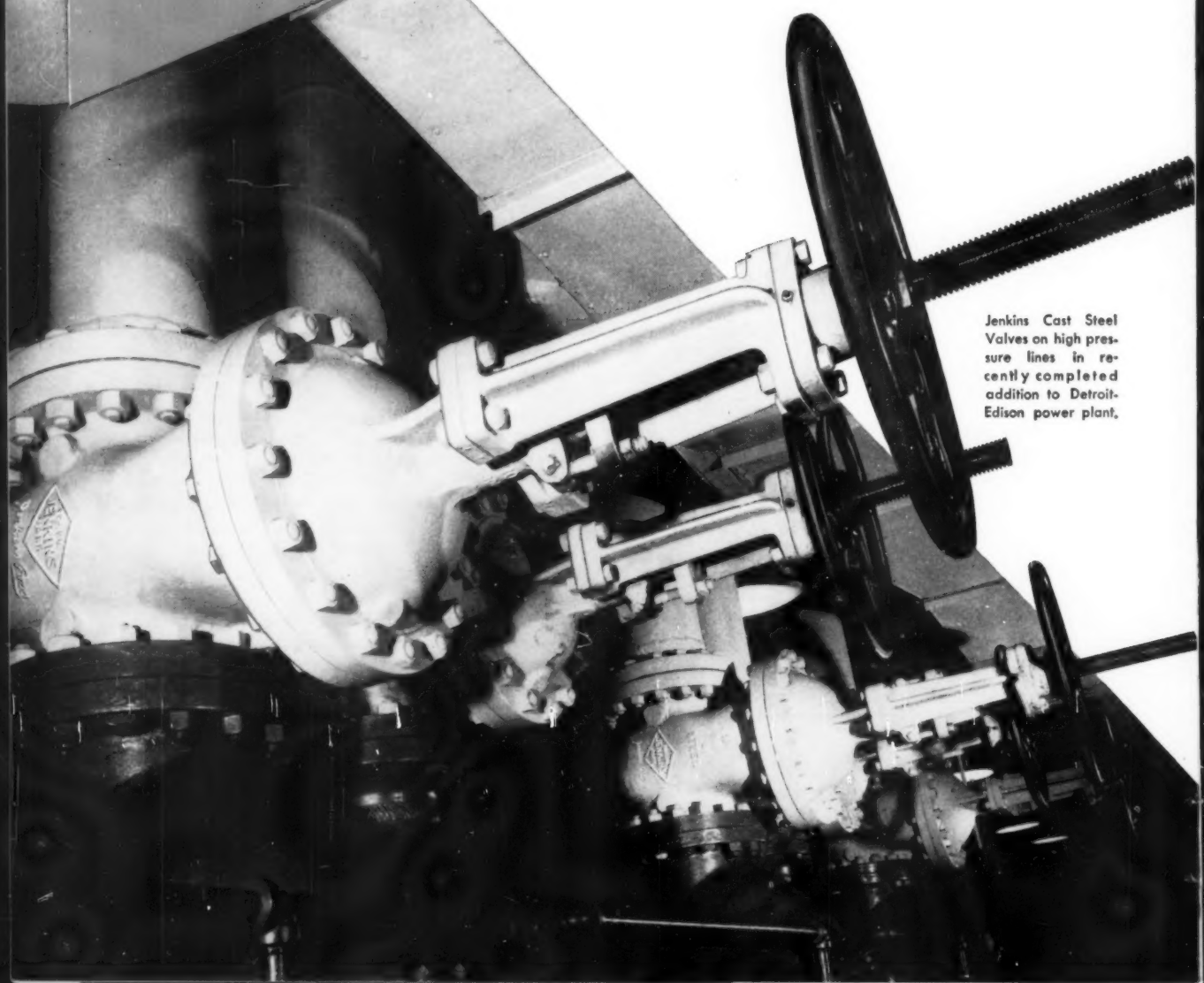

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Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

Radioactivity replaces skis in a new method of gaging next summer's water from this winter's snowfall, now being tried in California's high Sierra.

Instead of toiling over the snow pack to take measurements, the snow watchers headed for the hills last summer, planted radioactive cobalt in lead tubes. With the mountains now snow blanketed, these send signals up through the drifts to Geiger counters – the slower the count, the heavier and denser the snow. A telecoder and shortwave radio bring daily reports to a receiving station. This faster, more accurate method was developed at the Central Sierra Snow Investigation Laboratory of the Corps of Engineers.

TVA's new look was forecast for observant Power readers in the 1953 Modern Plant Survey (Mid-Sept issue). But even those who noted well the impressive list of TVA steam plants will be surprised to know that by 1956 the system will have twice as much steam capacity as hydro. Of a total output of 60 billion kwhr estimated for 1956, only 18 billion will come from the river system this vast public authority was created to develop.

The clouded crystal ball is the apt heading the New Yorker put on this quote from the 1880 meeting of the American Gas Light Association: "I am led to the conclusion that the electric light, which so recently, both in this country and in Europe, produced such commotion among holders of gas stocks, need give us little alarm. . . I presume every intelligent man is prepared to admit the possibility of electricity occupying in the future a certain place, of limited extent, in the general field of artificial illumination, unless after a fuller examination of its claims, it is found to be out of its sphere in this field."

New submarine cable connecting the Isle of Gotland and the Swedish mainland is believed to be world's longest and heaviest – 60 miles and 1000 tons. The single 180,000-cm conductor has 0.275 in. of mass-impregnated paper insulation, two concentric lead sheaths and steel-wire armoring. Rated at 100 kv, dc, the cable is insulated for 425 kv because of possible overvoltages.

Launching of atom sub "Nautilus," recalled to historians of Lukens Steel Co. another "first" of 129 years ago – the iron-hulled steamship Codorus. Hull plates for both these innovators in ship construction were rolled by Lukens.

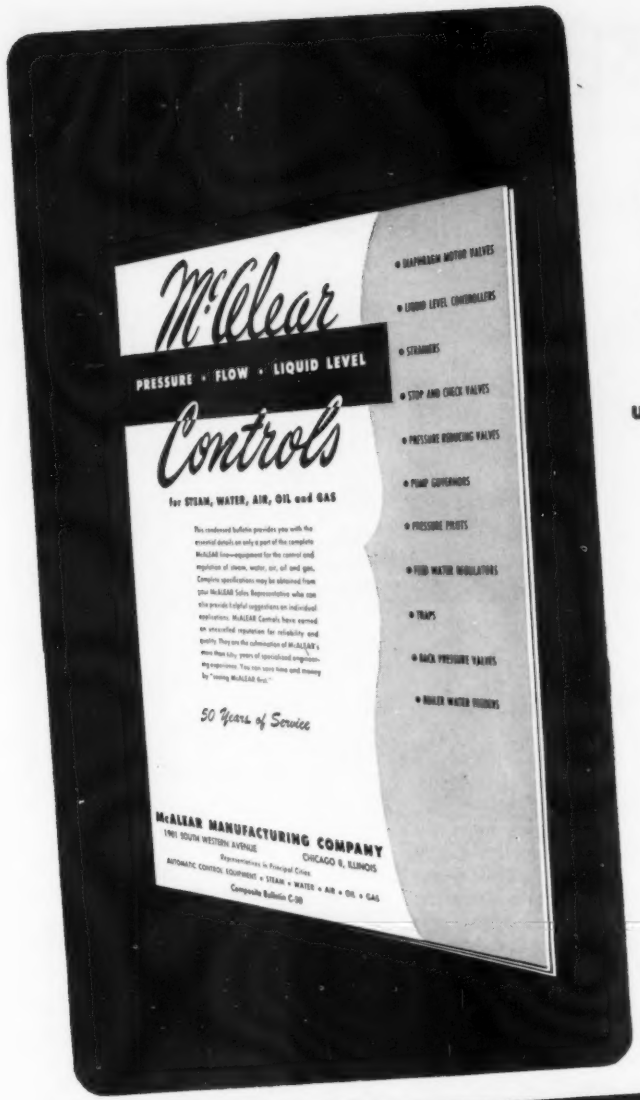
First to roll boiler plate in U.S., the Lukens mills supplied it for George Stephenson's pioneer locomotive "Rocket." And, more than a century later, they rolled the engine bed for the first diesel streamliner – the Burlington "Zephyr."

Utility demand for coal will account for close to one out of every four tons produced in 1954, according to Appalachian Coals, Inc. Estimated output of bituminous in 1953 is put at 460 million tons, of which utilities took 112 million.

On another fuel front, incomplete 1953 figures indicate yield of residual fuel oil dropped below 18% of domestic-refinery runs. Although imports have been rising, total residual fuel has declined in every postwar year but one.

Quote of the month comes from Thomas E Murray, of the Atomic Energy Commission. In a recent address, he defined the expert as "one who avoids the small errors as he sweeps on to the grand fallacy."

Lee Lawley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TECHNICAL BRIEFS_____152
PLANT EQUIPMENT NEWS_____156
NEW FREE BULLETINS_____165

WINDING over hilly Ohio woodland, this giant conveyor carries coal at rate of 800 tph

Giant belt carries coal 4½ miles

► ONE OF THE WORLD'S longest permanent rubber conveyor-belt systems is now carrying coal across the isolated hills of Ohio. Installed by B F Goodrich Co, this rubber belt transports 800 tons of coal per hour over a twisting 4½-mile course from a strip mine near Beverly to the banks of the Muskingum River.

The entire system consists of 14 flights, or sections, of rubber belting ranging in length from 500 to 2964 ft, pulley-to-pulley distance. To install the 48,000 ft of belting needed for the conveyor, 50 rolls of belting, weighing up to 4½ tons each, were hauled to the site by motor freight from the Goodrich plant in Akron. A portable electric vulcanizer, weighing more than a ton, spliced the 36-in. belt-sections into an endless chain.

Fourteen conveyor drive motors, with a total capacity of 1435 hp, move the belt at 600 fpm—despite incline angles of as much as 12 degrees. This means that a ton of coal can leave the mine, travel over wooded hills, across the Muskingum and arrive at the storage area in just 39 minutes.

Coal carried by the new conveyor system serves as the source of fuel for Ohio Power Co's new 400,000-kw Muskingum River Plant located on a 108-acre site on the west side of the river near Beverly. Ohio Power's present reserves can feed new system for several years.

New plant produces oxygen by the ton

► A TONNAGE OXYGEN unit, the only one of its kind in Canada, is now producing the vast quantities of oxygen required for direct flash smelting of copper concentrates. Built by Canadian Liquid Air Co, Ltd for International Nickel Co of Canada, Ltd, the new *Oxyton* separates oxygen from atmospheric air by the liquefaction process.

International Nickel's operations call for a volume of more than 7½-million cu ft of oxygen every day—enough to fill 32,000 standard cylinders. To handle this demand, *Oxyton* produces 300 tons of 95% pure oxygen every 24 hours. Inco's new oxygen flash smelting process eliminates the fuel normally required for smelting and makes economical the present large-scale output of liquid sulfur dioxide from furnace exhaust gas.

In recent years, leading research scientists have been growing more aware of the far-reaching possibilities of large-scale oxygen applications in metallurgical and chemical industries. Their studies lead to the conclusion that oxygen, employed in tonnage volumes, will transform present industrial processes within the next generation.

For coming events see page 252

American Power Conference

► SIXTEENTH ANNUAL MEETING of the American Power Conference will be held on March 24-26, 1954 at the Sherman Hotel in Chicago. This conference is sponsored by Illinois Institute of Technology in cooperation with 12 universities and 10 local and national engineering societies.

Purpose of the conference is to provide a forum for the exchange of information in power generation, transmission, distribution and utilization. All interested persons are invited to attend. For additional information, write E R Whitehead, secy APC, Illinois Institute of Technology, Technology Center, Chicago 16, Illinois.

Below is a brief listing of some of the outstanding topics that this 1954 meeting will cover:

Wednesday, March 24, 1954

INTRODUCTORY ADDRESSES: Research and the Electric Power Industry; The Power Industry—a Challenge to Engineers.

CENTRAL STATION STEAM GENERATION: Performance of New Controlled-Circulation Boilers; Cyclone-furnace-fired Boilers; Pulsation-induced Vibration in Utility Steam Generation Units; The Present and Future Status of the Flyash Disposal Problem.

HYDROELECTRIC POWER DEVELOPMENT in the United States: The Role of the Corps of Engineers in the Development of Water Resources; The Federal Multiple-Purpose Project—Its Role in the West.

INDUSTRIAL PLANT SESSION: Scale Modeling—a Practical Engineering Construction Tool; Selection, Maintenance and Piping Practice in Industrial Plants; Planning and Installing an Electrical System in a Rapidly-growing Industrial Plant.

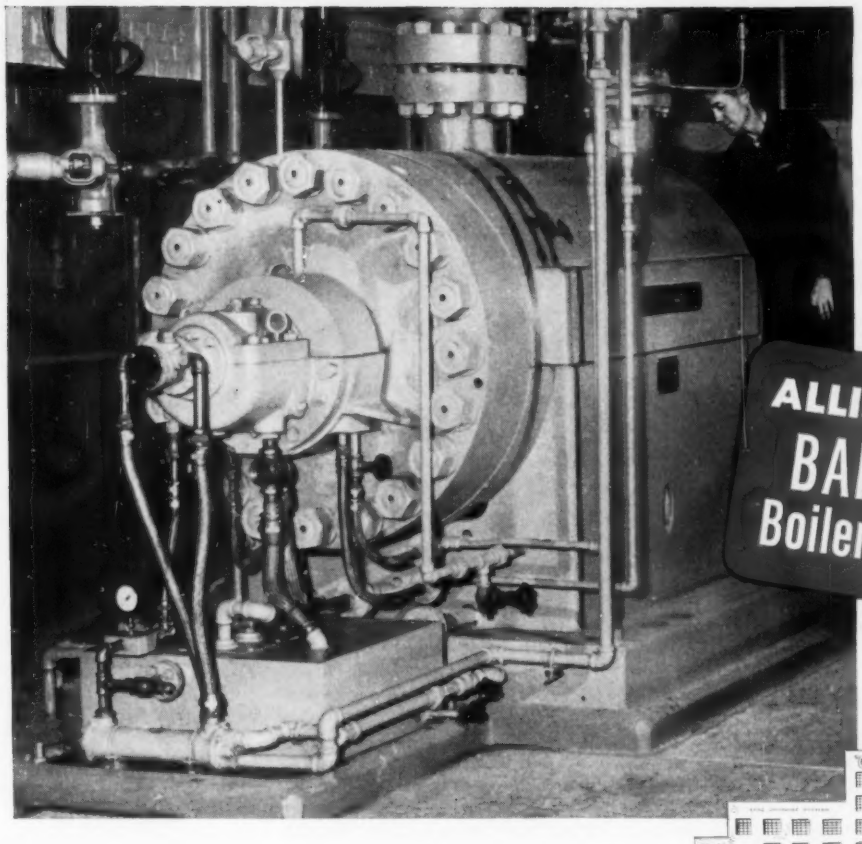
Thursday, March 25, 1954

CENTRAL STATION STEAM TURBINES: Steam Turbine Development; Trends in Design of Present Day Steam Turbines; The Steam Turbine of Tomorrow.

FUEL ECONOMICS: Future of Coal in Power Generation; Nuclear Fuels for Power Generation.

WATER TECHNOLOGY: Evaluation of Several Alkaline Compounds for Controlling Corrosion in Boiler Feedwater Systems; High Temperature Water for Process Heating Combined with Power Production; Demineralized Water for

(*Continued on page* 250)



One of three barrel-type boiler feed pumps at the Lake Catherine station of Arkansas Power and Light Company. Rated at 525,000 lb/hr, 1800 psig discharge, 3575 rpm, water temperature 350 F. Station engineered by Ebasco Services, Inc.

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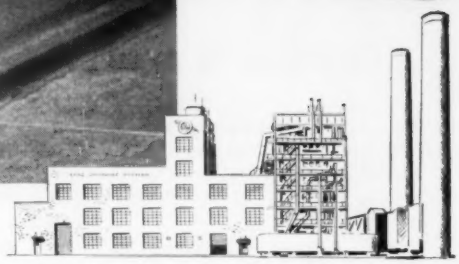

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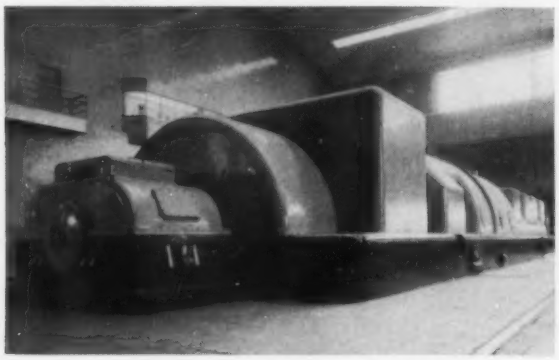

Kearny reheat turbines are . . .

First units to use 1100-F throttle steam

The New Kearny Generating Station, Public Service Electric and Gas Co. *By F P Fairchild, Chief Engineer, Electric Engineering Dept, Public Service Electric and Gas Co.*

Extension to Kearny generating station consists of two 145-mw units using steam conditions of 2350 psig and 1100/1050 F. Calculated net heat rate at full load equals 8830 Btu per net kwhr. New units were built as an essentially separate plant using semi-outdoor boilers, lower elevation of operating floor and other features differing from existing plant.

Units use eight closed heaters each, with deaeration performed in the condenser hotwell. Full-load feed temperature to boiler is 508 F. Each unit has two boiler feed pumps and there is a spare pump that can serve either unit in emergency.

The 955,000-lb-per-hr steam generators incorporate controlled circulation, pressurized firing, twin furnaces, flue-gas recirculation and continuous discharge wet bottoms. While normal operation will be with pressurized firing using forced-draft fans capable of delivering 40.37 in. H_2O head, there are also induced-draft fans for suction firing. Gas-recirculation fans take gas leaving economizer and deliver it to furnace ports between middle and lower level of coal burners. Increased mass flow helps to maintain superheat when burning coal at a lower furnace temperature and minimizes slagging of heating surfaces.

To make furnace gastight, pressure barrier is placed at waterwall tubes. Each tube is welded to a bar spacer placed between adjacent tubes. Each boiler has three vertical single-stage circulating pumps rated for 40-psi differential head at a flow of 7300 gpm. Two pumps run at full load. Boiler has been run up to 145,000 kw with one pump alone.

Each turbine drives two generators, main 137.5 mw 20-kv generator and an auxiliary supply generator of 10 mw rating developing 4160 v. This provides better station stability in event of outside system electrical disturbances and always maintains a residual load on unit so that it can be kept running and ready to pick up load.

Turbines have side exhausts discharging into twin condensers. Each condenser unit consists of two 35,000-sq-ft single-pass condensers, one on each side of turbine. Exhaust steam enters tube banks horizontally and flows up to air-cooler section at top while condensate falls into hotwell below. This arrangement allows reduction of height between condenser floor and operating floor to 25 ft, a reduction of 11 ft over previous designs used by this company. *ASME Paper No. 53-A-71.*

Reheat Turbines at Chesterfield and Kearny Stations. *By C W Elston, Manager, Turbine Engineering, General Electric Co.*

Chesterfield No. 3 unit of Virginia Electric and Power Co is a typical modern reheat turbine while Kearny Units 7 and 8 of Public Service Electric and Gas Co, New Jersey, are of advanced reheat design using high steam conditions. First unit is a 90-mw ASME-AIEE preferred standard reheat unit and last two are 145-mw tandem-compound triple-flow reheat units. Reheat units represent 92% of scheduled shipments of turbines by General Electric during 1954.

Chesterfield unit is opposed-flow tandem-compound double-flow reheat designed for 1450-psig 1000/1000 F. Opposed-flow arrangement of high- and intermediate-pressure sections with initial and reheat steam inlets adjacent to each other confines high temperatures to a single, relatively short portion of the turbine. This essentially eliminates temperature gradients across thick-wall portions of high-pressure inner casing. All shaft-end packings run at moderate or low temperatures, highest being the high-pressure exhaust section.

Kearny units are 3600-rpm tandem-compound triple-flow reheat turbines using 2350-psig 1100/1050 F steam conditions. Opposed-flow principle is used but an external control valve chest was made necessary by austenitic steel needed by 1100-F temperature. Six pipes connect the chest with the first-stage admissions. Because of the 1050-F temperature, double-shell construction is used at reheat inlet as well as main steam inlet. Cross under pipes connect intermediate casing and triple-flow low-pressure casing. *ASME Paper No. 53-A-92.*

The Economics of Large Reheat Turbine Exhaust End Size Selection. *By D W R Morgan Jr and S D Fulton, Steam Division, Westinghouse Electric Corp.*

This paper shows a method of studying large reheat steam turbine exhaust end sizes and other plant components affected by heat rejected to condenser. Results help in making an economic evaluation and selection of an appropriate end size.

Available exhaust end sizes vary from 65.2 sq ft of exhaust annulus to 205.9 sq ft. These apply in varying ranges to turbine capabilities of 100 to 300 mw. Method is based on curves showing difference in generator outputs for two similar turbines with different exhaust-end sizes, passing same steam flow.

Following data must be known or assumed to make an evaluation: (1) initial

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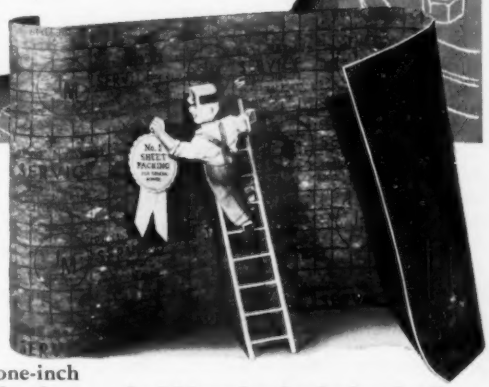

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Begins on page 152

and reheat steam conditions (2) exhaust pressure (3) capability (4) exhaust annulus area (5) heat rate at full capability (6) fuel cost (7) load factor (8) fixed charges (9) plant cost (10) steam generator efficiency (11) auxiliary loss (12) circulating water temperature (13) condenser tube size (14) circulating water tube velocity (15) circulating water total dynamic head (16) amount of one-half circulating water flow operation. In addition to these data there must be information developed on: (1) difference in building and foundation cost (2) difference in piping, boiler feed system and steam generator cost (3) difference in turbine-generator cost (4) evaluated fuel saving from reduced plant heat rate (5) evaluated fuel saving from reduced circulating-water pump power (6) difference in cost resulting from reduced condenser surface and circulating pump capacity (7) pumping power capability credit. Paper supplies data for items (4) to (7).

Method requires minimum amount of data for a preliminary analysis. Accuracy is great enough to define area needing more detailed analysis. In many cases no further study will be needed. Effect of partial loads, reduced vacuum in summer, increased building and foundation cost all make larger exhaust size less attractive. So if a standoff is indicated at full capability by the method outlined, a more detailed study will usually show smaller size to be more economical. Paper includes five short tables and ten graphs and a completely worked out example. *ASME Paper No. 53-A-93.*

Economic Determination of Condenser and Turbine-Exhaust Sizes. *By E H Miller, Supervisor, Turbine Advance Engineering, General Electric Co, and A Sidun, Manager Condenser Division, Foster Wheeler Corp.*

There are many combinations of condensers and turbine exhaust annulus areas that can be used in a given steam station. This paper offers basic data on turbine and condenser performance to help plant designer select most economical combination.

Method offered uses three basic steps: (1) find difference in station performance between combinations (2) find difference in station costs between combinations (3) place a dollar value on differences in station performance and compare with differences in cost.

Tables included give gross turbine heat rate differences for various exhaust annulus sizes and capacities. Steam conditions covered are 850 psig, 900 F; 1450 psig, 1000 F; 1450 psig, 1000/1000 F; 2000 psig, 1050/1000 F. Curves provide data on gross turbine heat rates for turbines of various capacities and with different last-stage bucket dimensions. Other curves cover single-pass and two-pass condensers in respect to heat transfer, cooling water flow, exhaust pressure and total pump power at different cooling water temperatures.

There is one table giving differential prices, foundation area and foundation length for different exhaust arrangements. Another table gives differential prices for single-pass and two-pass condensers of different surface areas. An appendix gives a completely worked-out example. *ASME Paper No. 53-A-94.*

Testing Large Steam Turbines With Weighing Tanks. *By W A Pollock, Technical Engineer of Power Plants, Wisconsin Electric Power Co.*

Forty-three years of favorable experience with weighed-water testing of steam turbines influenced decision to install scale tanks at new Oak Creek plant of Wisconsin Electric Power Co. These will allow accurate testing of new 120,000-kw cross-compound reheat turbines. Weighing tank installation costs less than 10c per kw of installed capacity. Tanks serve dual purposes of testing turbine and auxiliaries accurately and of storing cold condensate as needed.

Manufacturer's guarantees of turbine heat rates can be checked more reliably and closely with tanks than with flowmeters. With assurance of accurate testing methods, manufacturer frequently can improve his guarantee. Under such circumstances, experience shows manufacturer makes special efforts to provide very best design. He also encourages operation at closer clearances to attain better performance.

Other advantages are the help in evaluating turbine internal condition which may or may not require overhaul, and in learning effects of changes in clearance adjustments and in design changes.

Routine tests can be conducted with minimum preparation time and relatively small crew. Accurate measurement of steam flow, electrical output, pressure and temperature are needed for reliable results, but major emphasis on accuracy applies to input and output quantities which have greatest effect on result.

On unit installations, performance of nearly all equipment may be calculated from test observations made for a turbine-generator. Some of these are: (1) condenser performance (2) condenser circulating-water-pump capacity and efficiency (3) condenser leakage (4) boiler-feed-pump capacity and efficiency (5) extraction heater performance (6) hotwell-pump capacity and efficiency (7) flow-meter calibrations for use in boiler heat-balance calculations.

Author estimates that a series of three runs on a turbine with test tanks costs about $670. This includes allocated manhours for test crew and fixed charges on tank installation. *ASME Paper 53-A-66.*

Maintenance and Effect on Manpower and Power Production Costs of Steam Generating Stations. *By G V Williamson, Supt of Steam Engineering, Union Electric Co of Missouri.*

Maintenance and manpower costs are affected by: (1) plant design and selection of equipment, (2) work conditions, such as use of traveling crews or outside contractors—variations that make it impossible to obtain comparable data on maintenance crews, (3) load—base vs peaking, (4) local coal and circulating water characteristics, (5) age of plant, necessity for keeping it on load, overloads, (6) administration and engineering skill in maintenance policies and practices.

The following table shows no dependable guide can be given as to size of crew needed for maintenance in a given plant:

Size class, mw	Age class, yrs,	Maintenance labor, ¢ per kwhr	Material excl coal, ¢ per kwhr
400	10+	0.020	0.013
500	10+	0.020	0.013
500	10+	0.030	0.025
300	10+	0.035	0.035
500	10+	0.035	0.035
300	10+	0.030	0.020
300	10–	0.015	0.008
200	10–	0.013	0.008
100	10–	0.010	0.008
Avg		0.025	0.018

System used to analyze and control

(*Continued on page* 220)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Society of Mechanical Engineers, annual meeting, Nov 29-Dec 4, Hotel Statler, New York, N. Y. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.

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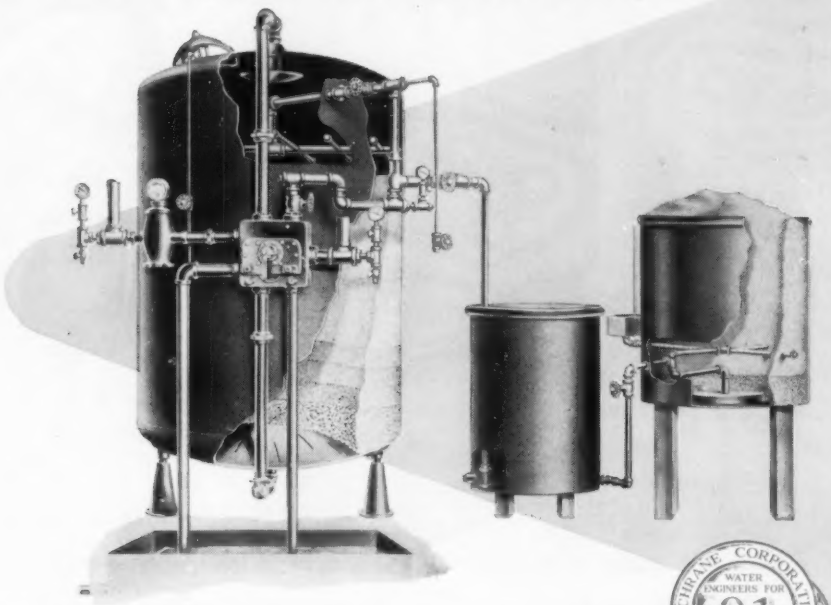

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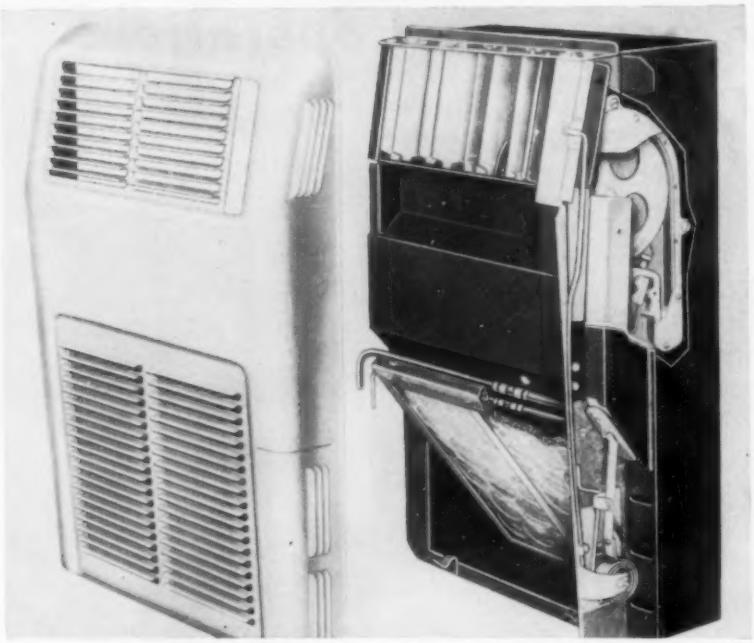
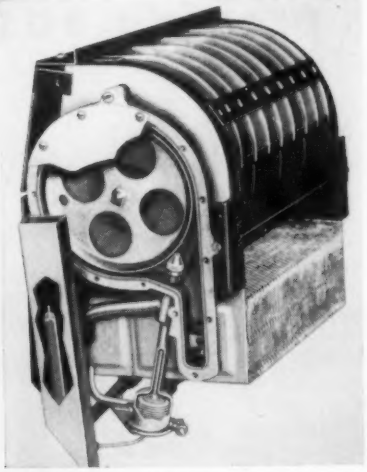




INTERNAL VIEW of heater shows fan turbine wheel, steam throttle valve and nozzle assembly, and heat-transfer core

HEATER with grille removed, at left, shows filter in position. Air enters unit at bottom, passes back into room from top

New Heating System Features Separate Thermostatic Control for Each Room

301 • Advanced new method of heating, already in use for three years in limited areas, is today giving outstanding performance in many types of residential and commercial buildings. *SelecTemp* system has just been released for national distribution and can be installed economically in both new and existing buildings.

Individual room heating units operate independently and thermostat settings can range from 40 to 90 F. Thermostat regulates both circulating fan and steam supply to meet heating requirements exactly. Units modulate from 1/20 capacity to full capacity to maintain heat level at various settings.

Modern trend toward extended floor plans and large window areas makes zone control essential to comfortable and economical heating. With *SelecTemp* system, each room is a zone equipped with its own precise control. The heating unit in each room quickly responds to changes in outdoor temperature, wind direction and speed as well as to indoor changes resulting from fireplaces, ovens and various other heat sources.

Low pressure steam, supplied to each unit through small flexible copper tubing, provides heat and also power for the steam-turbine driven circulating fan. Thermostats are non-electric and require no wiring. Removable spun-glass filter in each unit cleans circulating air. Boiler may be placed in any convenient location and still distribute heat properly to every room.

Further details and descriptive literature are available on request to manufacturer.

Iron Fireman Manufacturing Co, Cleveland 11, Ohio

Oil-Fired Unit Heater

342 • New unit heater is claimed to be first of its type to be fired with a conventional gun-type oil burner. Vertical flue travel permits gas to be exhausted through short flue pipe without use of high-draft, permanent chimney. Burner and flue outlet attach to either side of heater if location makes this change necessary. Output is 220,000 Btu/hr when fired with 2 gal/hr nozzle. Air delivery is 5730 cfm with heating range of 150 ft. Complete unit and control system weighs only 390 lb. Full details available on request to manufacturer.

Delta Heating Corp, Trenton, N. J.

High-Low Velocity Filter

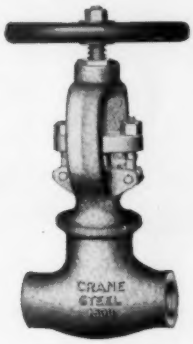
337 • New one-inch air filter is efficient in both high and low-velocity systems and holds up to 800 grams of Standardized Fine Air Cleaner Test Dust between cleanings. Manufacturer claims unit maintains sustained performance without low pressure loss. Filter operates efficiently between 800 and 1200 cfm per 20x20-in. panel.

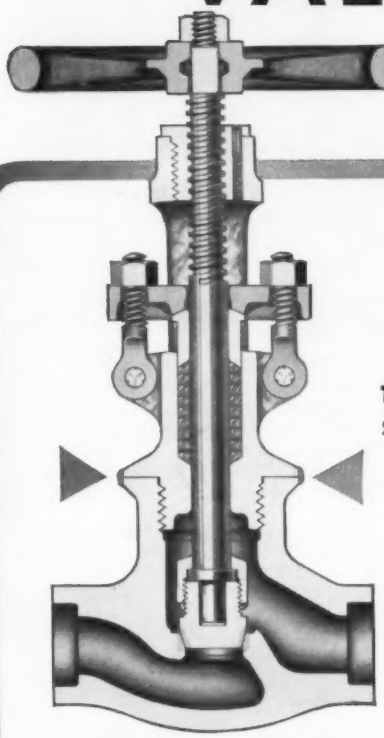
Farr Co, PO Box 10187, Airport Station, Los Angeles 45, Calif.

For more data on these items, use post cards p 165. Identify your request with item number.

newest in small steel valves for high-pressure/high-temperature

CRANE
lip-seal bonnet (patented)
VALVES





Lip Seal design is exceedingly simple. Body and bonnet are screwed together until a firm metal-to-metal contact is made between the smoothly machined flat surface on the shoulder of the bonnet and the top of the body. The small lips around the periphery are then seal welded.

- **Absolute Bonnet-Joint Tightness**
- **Freedom from Bonnet-Joint Maintenance**
- **Minimum Weight and Bulk**
- **Easier Dismantling and Reassembly**

1500 AND 2500-POUND GLOBE AND ANGLE PATTERNS
SOCKET-WELDING AND SCREWED ENDS. SIZES ½ TO 2-INCH

What better way to seal against leakage at the bonnet joint of a small steel valve . . . than with a simple weld. And that's all the weld is ever called upon to do. Extra-long body-bonnet threads carry all mechanical loads—and at comparatively low stresses. Should dismantling be necessary, the seal weld may be repeatedly ground off—and reapplied—without damage to valve.

Right along with this modern Crane sealing principle go other important refinements. You get a compact, weight-saving structure without sacrificing strength or reducing seat area—a more rigid swivel disc-stem connection—durable Stellite-faced plug-type disc—and Stellite-faced integral seat.

Crane Lip-Seal Bonnet Valves are by far your best buy for high-pressure/high-temperature power services . . . worthy companions to the larger Crane Pressure-Seal Valves. Ask your Crane Representative for Circular AD1902, or write direct.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

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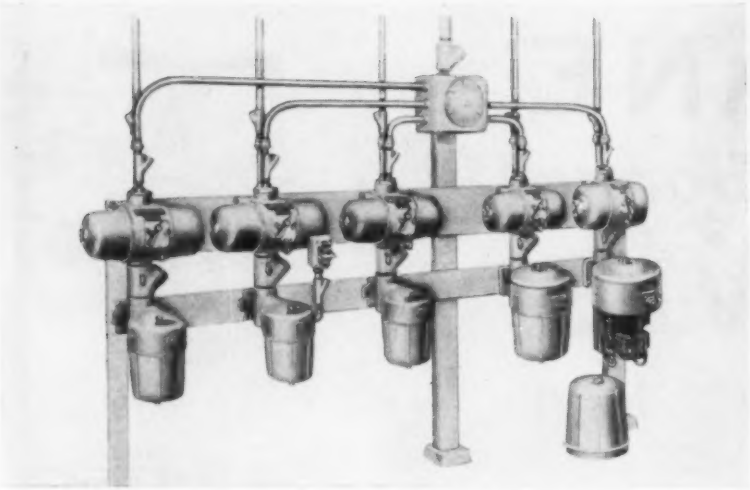


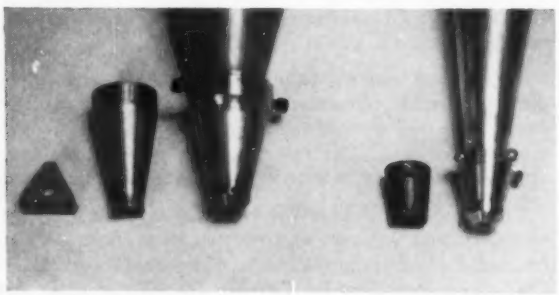
Explosion-proof Enclosures for Circuit-breakers, Line-starters

302 • Completely new line of explosion-proof dust and rain-tight circuit-breaker, motor and line-starter combination enclosures effect substantial money savings by eliminating unnecessary down-time of machines and equipment in hazardous areas. These enclosures carry UL approval, and with a new UL-approved sealing *Unilet*, may be joined in combination to meet UL requirements in certain sizes.

Each component *Unilet* for circuit-breaker, motor-starter and seal possesses full 7-thread engagement at coupling joints as well as on bolt-free covers. Individual motor-starters in both single and banked combinations offer absolutely safe entrance for maintenance in hazardous areas without shutting off other branch circuits. No live breaker wires are exposed while motor-starter enclosure is open on a line-starter combination.

This new line of equipment covers all leading breaker-starter controls rated to 225-a breaker loads and to 100 hp on 3-phase induction motors at 600 v maximum. Full details available in Bulletin 12-A.

Appleton Electric Co, 1701-59 Wellington Ave, Chicago 13, Illinois



Simple Nozzle Adapter Broadens Uses of "Squirt" Welder

303 • Extremely simple and inexpensive nozzle adapter for conventional semi-automatic or "squirt" welder promises new and wider uses for this machine. Device makes possible deposit of various alloys at speeds surpassing even those of full automatic welding head. Process utilizes magnetic field created by passage of electric current through bare electrode, plus a magnetic alloy flux that coats wire immediately ahead of welding arc. Permanent magnets in nozzle adapter act as dam to flux flow whenever arc is broken.

Squirt welders now in common use lend themselves readily to operation with magnetic alloy flux. Adapter tip containing permanent magnets replaces standard tip, centers wire to assure concentric flux coating and governs amount of flux applied. Manufacturer claims deposits are sound and have consistency and uniformity characteristic of automatic welding method. A series of magnetic flux materials designed for both build-up and application of hardfacing overlays will soon be available.

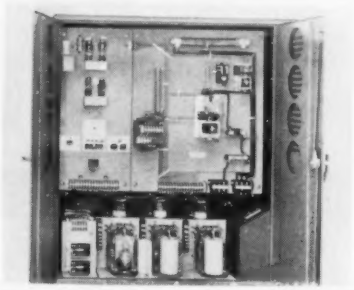
Literature describing alloy flux and adapter nozzle is available from manufacturer.

Stoody Co, Whittier, California

Area-Volume Calculator

346 • Unique time-saving calculator operates like slide-rule, reads like table and gives areas or volumes to nearest sq ft. Device measures 3¾x9 in. and is of lifetime vinyl plastic.

Paul S Morton Engrg Service, 609 Bangor Rd, Lawrence, Mich.

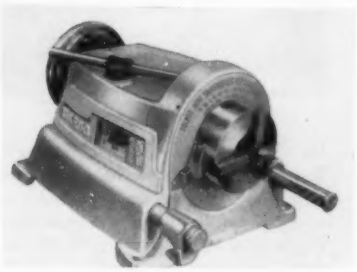


Power Drive

347 • New mercury rectifier variable-voltage power drive provides another way to convert ac to controlled dc variable voltage for application to adjustable-speed drive equipment. New equipment consists of (1) operator's control station (2) adjustable-speed drive motor (3) control unit enclosed in 56⅝x63¾x28-in. cabinet. Manufacturer claims space and weight saving features more than offset slight initial cost increase. Further details are available on request to manufacturer.

Reliance Electric & Engrg Corp, 1088 Ivanhoe Rd, Cleveland 10, Ohio

For more data on these items, use post cards p 165. Identify your request with item number.



Power Drive

348 • New power drive for fast, efficient operation of hand pipe threaders, cutters and reamers offers weight reduction to 140 lb, easy portability and ruggedly constructed compact unit. Unit converts hand tools to power in or out of shop. Capacity ranges from ⅛ to 2-in. pipe, ¼ to 1½-in. bolts; with universal drive shaft, geared die stocks and cutters up to 12 in. Available with set of legs and tool tray as accessories, unit can also be mounted on bench or service truck. Further details from manufacturer.

Toledo Pipe Threading Machine Co, Toledo, Ohio

This building was "PROTECTED" too.

Famous City Hall "Blows its Top"

A burner Flame-Failure explosion literally blew the roof off of the famous city hall at [redacted], [redacted], causing $55,000 damage and disrupting government.

Such explosions occur when burner flames fail and shut-down of fuel is not immediate. In a few seconds, still-flowing fuel forms dangerous gases which ignite explosively on hot fire brick.

but...

like 4 out of 5 burner installations the Flame-Failure Protection was too slow to prevent explosion!

YOUR FLAME-FAILURE SAFEGUARDS should shut down fuel supply within 2 to 4 seconds in order to prevent explosion when a burner flame goes out. Actually, the "safeguards" in 4 out of 5 plants burning oil, gas or coal, simply do not meet this requirement, or other insurance company standards. So you may think you're safe . . . yet you may be risking a costly explosion!

Here's The Protection You Need

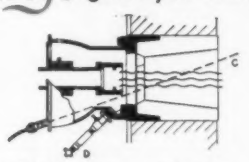
Today, it is unnecessary to depend on slow, half-safe controls. It costs so little to replace them with the modern electronic FIREYE System — the only fully approved, complete and instantaneous safeguard for all types of fuels. With FIREYE, an electronic eye "sees" the burner flame . . . and if the flame fails, it works with the speed of light to cut off fuel and warn operating personnel. FIREYE Systems are quickly and easily installed, and the cost is low.

BE SAFE! SEND TODAY! Send now for this authoritative guide, compiled by the pioneers of instant electronic Flame-Failure protection. Long experience in the research and manufacturing of FIREYE Flame-Failure safeguards makes Combustion Control Corporation the one company best qualified to write on this subject — the one company offering you Firetron, the Flame-Failure sensitive cell that sets the standard of dependability.

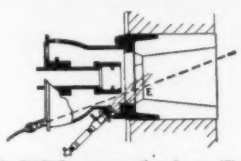
FIRST and FOREMOST IN INSTANT FLAME-FAILURE PROTECTION

fireye

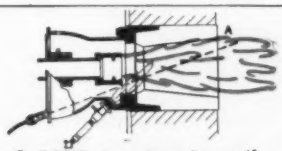
How fireye gives you complete flame-failure protection



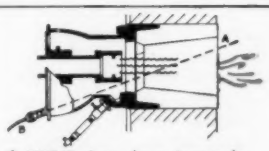
1 FIREYE purges combustion chamber (C) before igniting pilot (D) . . . to eliminate any gases accumulated from leaking valve during down time.



2 FIREYE proves pilot flame (E) before turning on main fuel. Pilot may have failed to light because of fouled electric igritors, no fuel, or poor fuel-air mix.



3 FIREYE shuts down burner if main flame (A) is not ignited at end of safe trial period (due to no fuel, poor fuel-air ratio, or incorrect draft.)



4 FIREYE shuts down burner in 2 to 4 seconds if main flame fails due to poor fuel-air ratio or draft, or fuel interruption. POSITIVELY PREVENTS EXPLOSION.

COMBUSTION CONTROL CORPORATION

Dept. C9-3, 718 Beacon Street, Boston, Mass.

More EQUIPMENT NEWS

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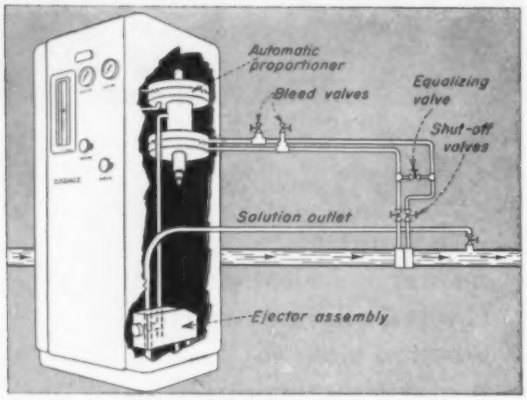
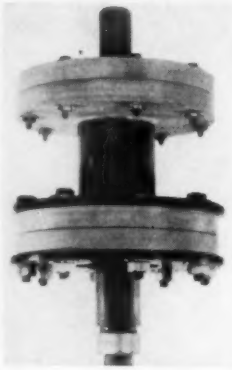
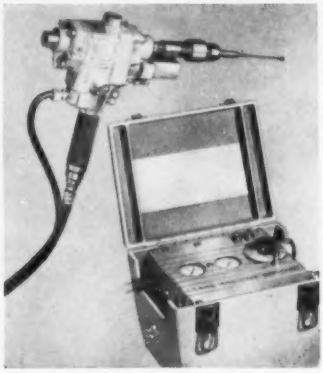






New Proportioning Component Feeds Chlorine Automatically

304 • New corrosion-resistant automatic proportioning component for chlorinators feeds chlorine to water or sewage lines in direct and preset proportion to flow rate however varied. Unit will handle whole proportioning job under conditions existing at most water and sewage installations.

Automatic proportioner, shown at right replaces differential pressure regulator used in manually controlled chlorinators. New component, connected by both high and low pressure taps at an orifice in main flow line, extracts differential pressure. Diaphragm then converts pressure to force. Pressure drop across chlorine rate valve changes so as to vary chlorine flow in direct proportion to flow of water.

Models are available for standard and high-capacity chlorinators in two standard differential ranges: 0-50 in. and 0-100 in. water column. For more details contact manufacturer at address listed below.

Fischer & Porter Co, 20 Jacksonville Rd, Hatboro, Pennsylvania

Tube Rolling Control

335 • New electro-pneumatic tube rolling control combines advantages of air operation with precision electric control. Unit's air motor provides increased power and flexibility with faster tube rolling and permits use of only one motor for wide range of tube sizes, both ferrous and non-ferrous. Capable of rolling ferrous tubes up to 2¼-in. ID, control is applicable to condensers, heat exchangers, boilers, evaporators, coolers, dehydrators, etc. Further details and operating data available from manufacturer.

Crane Packing Co, Dept P28, 1800 Cuyler Ave, Chicago 13, Ill.

Differential Pressure Cell

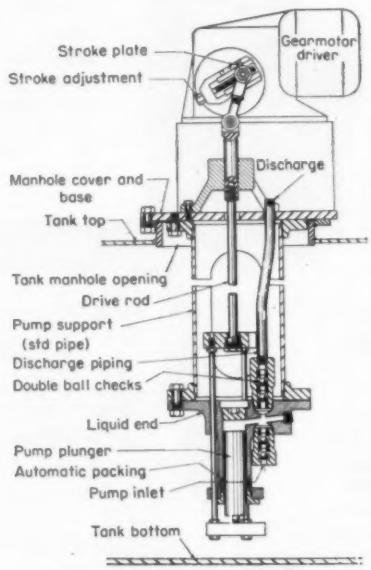
349 • New precision-type differential pressure cell, *Type MMB*, covers two ranges: ±15 psi and ±30 psi; max base pressure is 40 psi. Cell can be used in process control instrumentation for measurement of fluid flow and will transmit signals long distances without lag or time delay. Further details from manufacturer.

Baldwin-Lima-Hamilton Corp, Philadelphia 42, Pa.

Combination Filter

326 • New combination filter, regulator and lubricator eliminates complicated piping and fittings required for installation of individual units. Filter offers maximum cleaning area and easy change of filter units. Filling oil reservoir does not require shutting air line. Acting as a shutoff valve, this unit automatically bleeds downstream line to atmosphere. Combination unit is available for pipe sizes from ¼ to ¾ in. Further data from manufacturer.

Breco Mfg Co, Baltimore 2, Md.



Controlled Volume Pump

320 • New controlled-volume pump, the *Mersemetric*, has no diaphragm or open seal. Unit submerges completely in liquid being pumped so there can be no external leakage under any conditions. Capacities range from three ml per hr to 400 gph; pressures up to 1000 psi. Bulletin 1153-B.

Milton Roy Co, 1300 E Mermaid Lane, Philadelphia 18, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.

Large Capacity Filters

308 • New line of compact, large capacity filters provides filtration areas up 720 ft and cake space capacity up to 35 cu ft. Filter medium is high temperature-resistant porous stainless steel and container can be either carbon steel or corrosion-resistant stainless.

Manufacturer recommends units for clarification service and solids collection with such diverse fluids as water, petroleum products and molten metals. Special filters will be designed for specific applications.

Micro Metallic Corp, Glen Cove, N. Y.

You can get from **Revere** much more than **Tubes** and **Plates**

Because no one alloy can possibly meet all the various conditions of use, Revere makes condenser and heat exchanger tubes and plates in many different alloys. From its long experience Revere is able to give valuable collaboration on alloy selection.

Sometimes puzzling problems arise in operation. If tubes do not last as long as expected, consult Revere, no matter who made them. Sections of failed tubes will be helpful in determining causes.

In our experience, the main cause for shortened tube life is a change, or combination of changes, in operating conditions. The water supply may have been affected by a new source of up-stream pollution. Air entrainment is especially damaging and leaves unmistakable marks. Air can be drawn in through a leaky gasket. In one case, the source was traced back to a crack in the water pump casting. Occasionally we find that tube failure is due to increasing the water velocity beyond design limits in order to add to condenser capacity.

For a more comprehensive analysis of condenser tubes and what Revere can do for buyers and users of them, send for free booklet, "Life Extension for Condenser Tubes." See the nearest Revere Sales Office, or write direct.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

More EQUIPMENT NEWS

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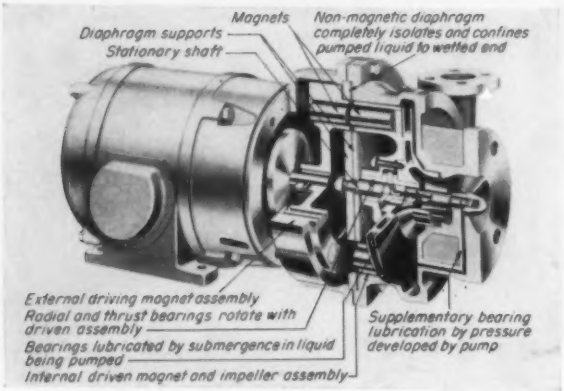

Magnets
Non-magnetic diaphragm completely isolates and confines pumped liquid to wetted end
Diaphragm supports
Stationary shaft
External driving magnet assembly
Radial and thrust bearings rotate with driven assembly
Bearings lubricated by submergence in liquid being pumped
Internal driven magnet and impeller assembly
Supplementary bearing lubrication by pressure developed by pump

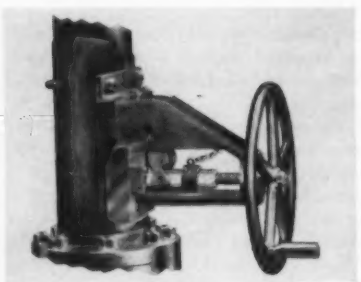
New Pump Isolates Liquids Completely

310 • New pump confines liquids to wetted end, has no rotating connection between driven pump end and liquid end. Unit has no rotating seals, no packing, no rotating member between driver and driven unit. Matching magnetic fields mounted around periphery of drive elements transmit power from motor to pump.

No connection exists between drive and driven magnets and, as a result, a non-magnetic diaphragm can be used to separate the two ends of the pump. This separation permits confinement of liquid to one end, thus eliminating possibility of leakage.

This magnetic-drive pump is an end-suction, horizontal centrifugal type unit. It consists essentially of an electric motor with permanent magnet drive assembly attached to rotating shaft. Driven end consists of driven magnet and impeller assembly, rotating thrust and radial bearings lubricated by pumped liquid, stationary shaft, pump volute case with end suction and top discharge. Unit can be powered with motors of 1, 1½ and 2 hp operating at 1760 rpm. Pump size is 1x2½x8 in. Full details on design and construction available on request to manufacturer.

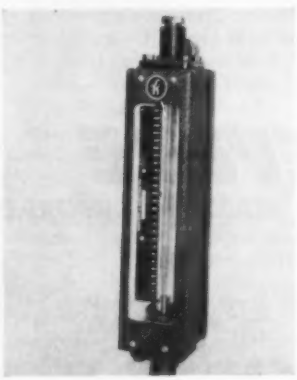
Peerless Pump Division, Food Machy & Chem Corp, 301 West Ave 26, Los Angeles 31, California



Emergency Handwheel

322 • New *Type Y* continuously-connected side handwheel provides emergency manual control in case of diaphragm or operating medium failure. Basic assembly has high-tensile iron frame fitted with oil-impregnated bearings. Screw is made of non-galling 18-8 stainless steel with high-tensile aluminum bronze nut for transmitting power through cast steel fork to valve stem. Mechanism provides stops that set travel to cover any portion of complete stroke.

Black Sivalls & Byrson, Inc, 7500 E 12th St, Kansas City 3, Mo.

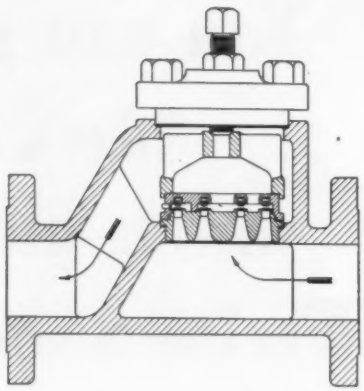


Safeguard Rotameter

319 • Newly designed rotameter features safety, accuracy and versatility in rate-of-flow measurement of liquids and gases. Completely enclosed steel meter case with detachable safety glass windows protects metering tube from external shock and acts as a safeguard in event of accidental breakage. Extra-wide front and rear sight windows provide maximum visibility. Scales are available in units of flow or in millimeters for use with calibration charts.

Schutte & Koerting Co, Dept M-D, Cornwell Heights, Bucks County, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.



High Pressure Valves

311 • New line of check valves is now available for air pressure conditions as high as 500 psig. Installed in discharge line of air and gas compressors, this valve checks downtime, noise, vibration and tank ring. Manufacturer claims it replaces stop and safety valves. Units are automatic. Full details in manufacturer's bulletin 509-C.

Pennsylvania Pump & Compressor Co, Easton, Pa.

Deaerators

350 • New line of deaerators are completely factory assembled and ready for installation in a variety of storage tank sizes. *Uni-Pac* is a package-type unit specially designed for small and medium size power plants. Outlet capacities range up to 60,000 lb per hr; storage tank capacities range from 35 cu ft to 250 cu ft. Equipment is available in both right and left hand types as determined by location of steam inlet facing tray door. Further details available.

Cochrane Corp, 3106 N 17th St, Philadelphia 32, Pa.

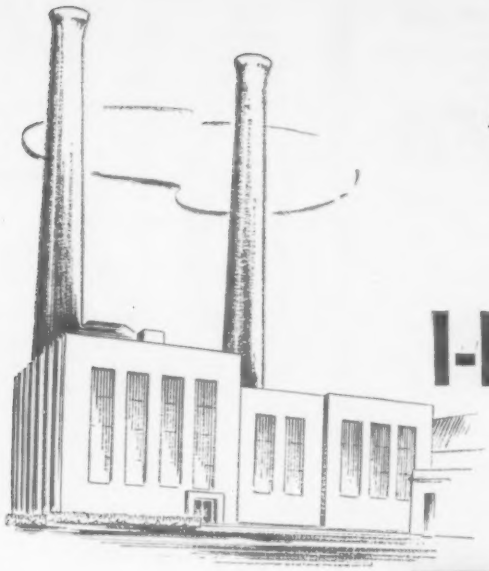
Moving-Scale Indicator

351 • New type of remote indicating device consists of moving strip scale behind fixed hairline. Since strip scale is always read at eye level and since separation of scale and hairline is very small, parallax error is low and reading accuracy increases. Although present model was designed for use with flow meters as the primary sensing element, manufacturer claims this device is adaptable to any primary instrument.

Fischer & Porter Co, 10A Jacksonville Rd, Hatboro, Pa.

CHECK THESE TOO . . .

Expansion Joints . . . . . p 170
Metallic Bellows . . . . . p 172
Chemical Feeder . . . . . p 174
Heavy Duty Limit Switch . . . . . p 176
Motor-driven Switch . . . . . p 178
Reel Handling Truck . . . . . p 180
Cable Puller . . . . . p 182
Tractor-Drive Generator . . . . . p 188
Compactor Power Float . . . . . p 190
Vibration Isolator . . . . . p 192



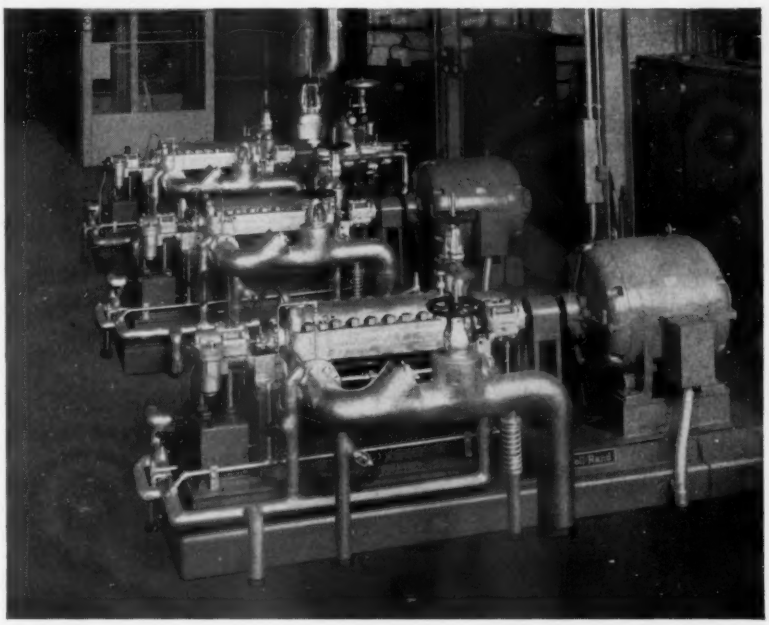
Western Electric

installs three

I-R BOILER FEED PUMPS

at *modernized*

Hawthorne Power Plant



Three 8-stage I-R Class HMTA boiler feed pumps installed at Western Electric Company's modernized Hawthorne Plant.

To meet the increasing steam and electric power requirements of Western Electric Company's huge Hawthorne Works in Chicago, the Power Plant has recently been completely re-equipped and modernized for greater capacity and higher operating efficiency. Savings in power costs, due to more efficient steam and electric generating equipment and auxiliaries, are estimated at $360,000 per year.

Plant capacity is now ample to meet the current manufacturing load of 650,000 lb. per hour for heating and process steam and 26,000 kw for electric power. Three Ingersoll-Rand Class HMTA boiler feed pumps serve the three high pressure boilers in this completely modern industrial power plant. Each unit delivers 700 gpm of 210° F water at 1130 psi. Two of the pumps are motor-driven and one steam turbine driven.

These advanced design pumps, with I-R Unit-Type Rotor Assemblies, assure sustained high efficiencies and low maintenance. For the last word in modern design and service-proved dependability, it pays to specify Ingersoll-Rand centrifugal pumps. The complete I-R line includes types and sizes to meet every power plant requirement. For further information, contact your nearest I-R engineering representative. He will be glad to help you.

Ingersoll-Rand

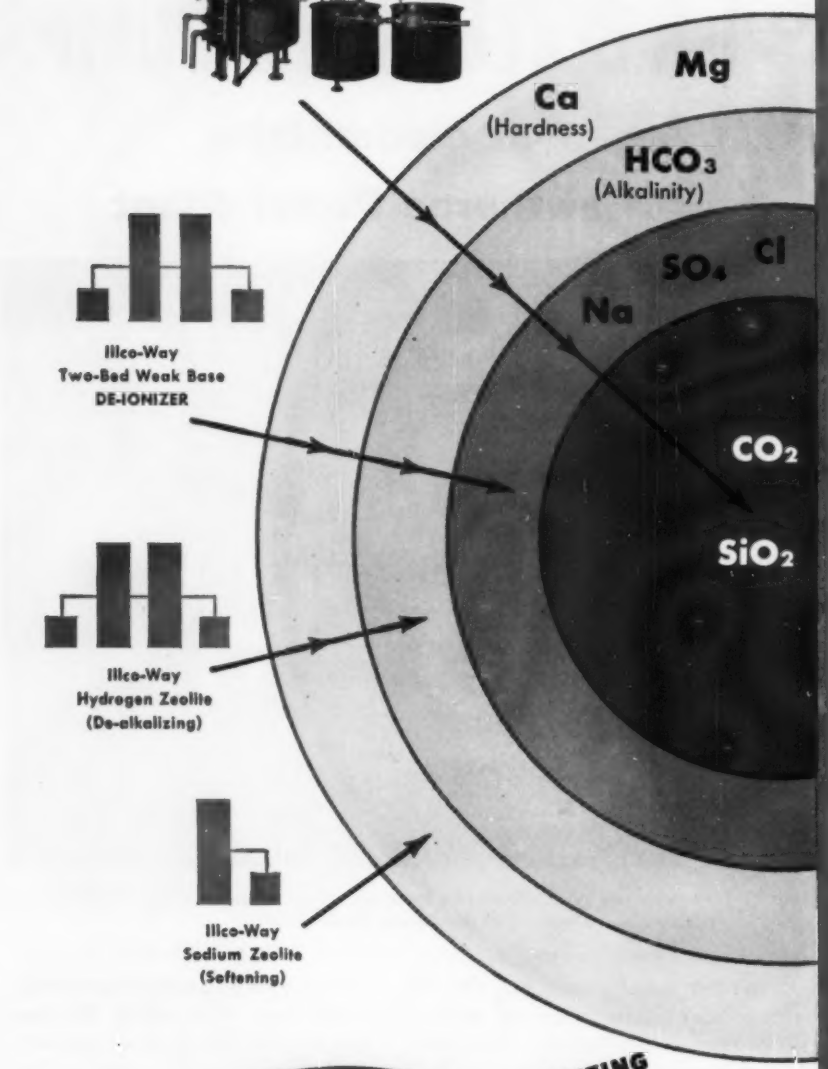
958-10 Cameron Pump Division

11 BROADWAY, NEW YORK 4, N. Y.

PUMPS • COMPRESSORS • GAS AND DIESEL ENGINES • TURBO-BLOWERS • ROCK DRILLS • AIR AND ELECTRIC TOOLS

Even Silica and CO_2 are removed with

ILLCO-WAY **MIXED-BED** DE-IONIZER



ILLCO-WAY DE-IONIZING DE-ALKALIZING SOFTENING

ionXchange

ILLINOIS WATER TREATMENT CO., 853-3 Cedar St., Rockford, Illinois • 141 E. 44th St., New York 17, N.Y.

Canadian Distributor: Pumps & Softeners Limited, London, Ontario

(Advertisement)

MIXED-BED strikes at the very heart of the water purification target . . . produces an effluent with solids reduced to a fraction of a ppm, and Silica and CO_2 removed. *If you require maximum purity in water,* get the facts about this exclusive Illco-Way ionXchange development.

Send for Bulletin A-353 ☐

TWO-BED DE-IONIZING. In the late '30's, Illco-Way fabricated and installed the first commercial De-ionizer utilizing cation and anion exchange. Equipment produces excellent water for process application where the equivalent of distilled water is required.

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HYDROGEN ZEOLITE process for removal of calcium and magnesium ions and alkalinity. This Illco-Way equipment efficiently conditions water for low-pressure steam boilers and for chemical processes where soft, alkaline-free water is required.

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ZEOLITE SOFTENING for removal of hardness is the basic ionXchange process which industry has put to widespread use for many years. Improvements in equipment and exchange material now provide even greater economies where soft water is required.

Send for Bulletin S-105 ☐

Pioneers in ionXchange

Illco-Way "firsts" include manufacture of the first commercial two-bed De-ionizer . . . the first commercial mixed-bed De-ionizer . . . and the development and building of the first successful installations for the purification of such liquids as beet juice and crude glycerol by ionXchange. . . . In the power field, boiler feed water treatment by Illco-Way ionXchange has long meant lower operating costs and increased operating efficiency. Installations are found in leading plants.

For complete literature in specific fields, send for catalogs listed above.

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Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here

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2 **Fans, blowers,** exhausters for industrial applications. Four-page, 2-color catalog sheet. Photos, specs, engrg data. Bulletin 501, Robinson Ventilating Co, Zelienople, Pa.

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4 **Automatic filters** designed for large air volume and high efficiency. Two-color, 12-page booklet. Photos, cutaways, dimensional drawings, full specs. Bulletin 500, Dollinger Corp, 11 Centre Park, Rochester 3, N. Y.

5 **Expansion compensator** for controlling pipe expansion in low pressure hot water or steam heating systems. Two-color, illustrated leaflet. Bulletin 138, Flexonics Corp, 1301 S 3d Ave, Maywood, Ill.

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8 **Television equipment** for relaying boiler water level gage readings. Equipment includes camera, illuminator, monitor, all necessary linkage. Bulletin WG-1813, Yarnall-Waring Co, Philadelphia 18, Pa.

9 **Combustion control** case history on $8-million boiler plant installation in Niles, Ill. Bulletin R-9, Hays Corp, Michigan City, Ind.

10 **Pressure gauges,** accessories and engineering information. 124-page booklet. Photos, dimensional drawings, full engrg data. Manning, Maxwell & Moore, Inc, Startford, Conn.

11 **Steam traps** that vent air from units eight times faster than ordinary inverted bucket traps. Two-color, 4-page folder. Photos, sectional drawings, specs and capacities. Bulletin 1153, V D Anderson Co, Dept H, 1935 W 96th St, Cleveland 2, Ohio.

CONTROLS

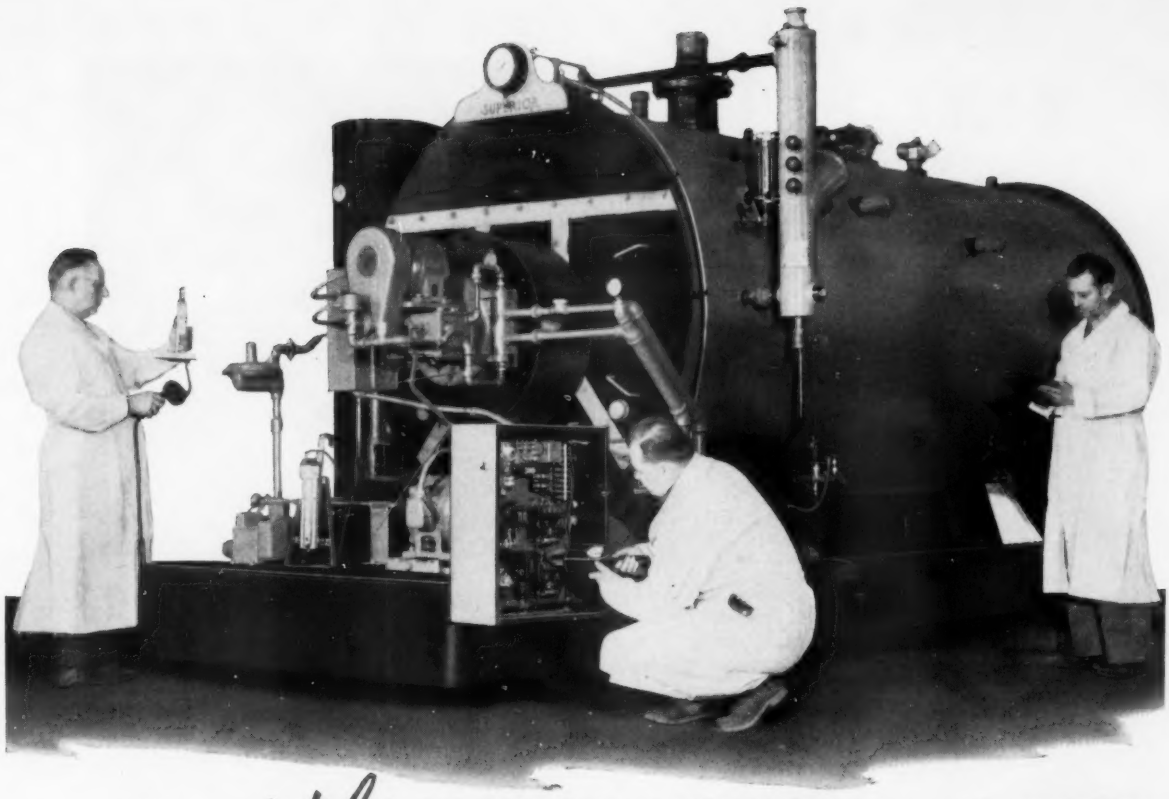
12 **Distribution regulators** for substation service. Two-color, 12-page booklet. Photos, cutaways, exploded views, dimensional sketches, full specs. Bulletin 21B7977, Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

13 **New control selection** guide on motor starters and pushbuttons. Two-color, 6-page folder. Photos and full specs. Bulletin GEA-6061, General Electric Co, Schenectady 5, N. Y.

14 **Control and alarm circuits** utilizing meter-relays. 8-page booklet. Photos, installation sketches, full specs. Bulletin 112, Assembly Products, Inc, Chagrin Falls, Ohio.

15 **Amplidyne systems,** how they operate and where they can be used. Two-color, 24-page booklet. Photos, cross-sections, circuit diagrams, charts, full specs. Bulletin GEA-4053, General Electric Co, Schenectady 5, N. Y.

(Continued on page 216)



Completely FACTORY ASSEMBLED and TESTED ...for a GUARANTEED RESULT

There's no guesswork about the performance of a Superior Steam Generator. Complete factory assembly followed by efficiency tests conducted *at the factory* under actual firing conditions guarantee operation at more than 80% thermal efficiency.

And because they are completely factory assembled and factory tested, they arrive at your plant ready to go to work . . . *backed by undivided responsibility*.

Fully automatic, firing either gas or oil, installation is simplified and inexpensive. Their rigid channel iron base eliminates the need of special foundations. Superior's built-in induced draft makes an expensive chimney unnecessary. All interconnecting piping and wiring is completed at the factory . . . ready for connection to supply services and steam outlet.

When the accent is on modernization, buy a Superior Steam Generator. It's the modern way to buy economical steam.

Five Superior Steam Generators ranging in size from 30 to 600 b.h.p. on the test line at the Superior plant in Emmaus, Pa.

18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i. or for hot water. For complete details, write for Catalog 600.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

George Edwards' Scrapbook

For years I've had an inferiority complex because I learned in school that the chemical content of the average human being was worth only 98 cents. Then along came the atomic age and I learned that the atoms in each pound of matter have an energy potential of 11,400,000 kilowatt-hours. Converting that into dollars and cents makes me feel pretty good. All I have to do now is cash in on myself. Any ideas?

* * *

There's much current speculation on "mining" the sea. Of course, this same sort of mining has been going on to some degree for some time, but it doesn't nearly match the all-out possibilities.

There are 320-million cubic miles of oceans, and each cubic mile contains about 166-million tons of dissolved salts. About 15.6 of this is magnesium chloride and magnesium sulfate; about 2.5% is potassium sulfate. That means each cubic mile contains about 4-million tons of magnesium. Some scientists believe that, by 1975, this metal should make up many common products in homes and factories.

In case you're interested, a cubic mile of sea water contains 2.7-million troy ounces of gold worth about $95-million and about 12-million troy ounces of silver worth about $8.5-million. There are many other elements to be extracted from sea water, but any method of getting at them will undoubtedly involve power. And once freed, these materials will find many applications in the power field.

Eli Whitney of cotton gin fame started us on the road to mass production. This illustration from STEELWAYS *shows him meeting with President John Adams in Washington in 1801. The President was going to cancel Whitney's two-year contract for 10,000 muskets because the time was up and Whitney had only 1000 to show.*

But Whitney astounded his audience by picking up parts piled at random on a table and assembling ten perfect rifles. His contract was renewed.

Before that time, all machine parts had been fitted by hand. Now, thanks to Whitney's milling machine, mass production was on its way. That took tools—and power.

Today, each of us in America supplies less than six per cent of the energy needed to produce all our goods and food. Tools supply remaining 94 per cent. And tools add over 16 pounds of food or goods to every pound man could produce by his own efforts. So machine tools, driven by power, are America's muscles.

I'm mentioning all this to show the importance of tools and power and to show why we must keep finding machines that do more work in less time—and why we must keep scrapping old equipment and keep building larger and more efficient power plants. Mass production and power go hand in hand.

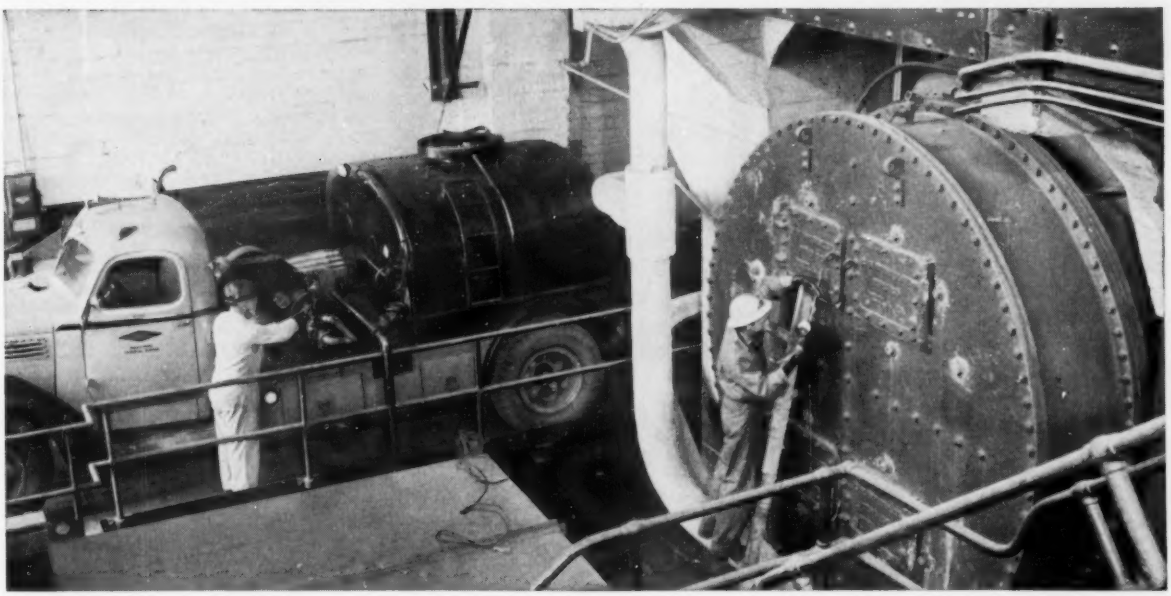
It's nice to know that President Eisenhower is one of us. Before going to West Point, he was a stationary engineer in the local dairy in Kansas. Fact is, he had the graveyard shift for several years. And, until he started making cars at the age of 42, Henry Ford was a stationary engineer for Detroit Electric. In Yugoslavia, Marshal Tito also earned his living by operating power plants before he got into politics. All this proves there is no telling where a smart power plant operator might end up.

George Edwards

Engineer

CHEMICAL CLEANING SAVED 400 TONS OF COAL PER YEAR

Fly ash, soot and carbonate deposits removed from condenser by Dowell; vacuum increased



Fly ash and carbonate deposits on the water side of an 800-KW turbo surface condenser had reduced vacuum from a normal 28″ to 24″. The temperature of the water leaving the condenser had dropped from 95°F. to 85°F.

These deposits were removed by Dowell Service with specially prepared liquid solvents. Result: the condenser was restored to its normal operating efficiency. The steam requirement was reduced by 2.5 pounds per kilowatt hour. On the basis of 8,000 hours of yearly operation, the plant engineer calculated a saving of at least 400 tons of coal per year.

Dowell chemical cleaning methods can be used on hundreds of different kinds of industrial equipment. Engineers especially trained for this kind of work do the job for you. They apply solvents according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. Dowell liquid solvents can go wherever steam or water will flow, reaching places inaccessible to other cleaning methods. Scaffolding is unnecessary. Dismantling and downtime are kept to a minimum.

A call for Dowell Service will bring experienced personnel to your plant within a few hours with all necessary chemicals, pump trucks and control equipment. For complete information and estimates on the cleaning of your equipment, contact the nearest Dowell office, or write directly to Tulsa, Dept. C-23.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

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DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

BALDWIN-HILL uses Power to help you keep heat losses down with

POWERHOUSE CEMENT

Here are six outstanding advantages:

- ONE COAT COVERAGE . . . It insulates as it finishes. Easy trowelling and quick hydraulic setting save time and labor in application.
- GREATER ECONOMY . . . 100 lb. covers 120 sq. ft. ¼" thick or 30 sq. ft. 1" thick. Low material cost and single coat application provide low over-all installation cost.
- NO WIRE MESH . . . In many instances can be trowelled directly on blocks, blankets, or other surfaces, thus saving costly application of reinforcement.
- DRIES WITHOUT CRACKING . . . Negligible lineal and volumetric shrinkage provides freedom from drying-shrinkage cracks.
- NO WEATHER WORRIES . . . Applied outside, it withstands drenching rain within two hours of application.
- PAINTABILITY . . . The smooth, firm, crack-free surface is perfect for finishing with oil-base or water-base paints.

For further information, get in touch with B-H Engineered Insulation Service.

Baldwin-Hill

Clip on signed letterhead and mail

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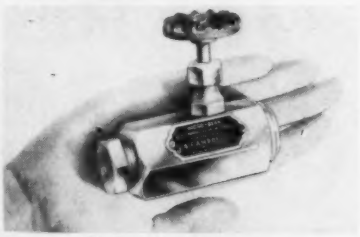
BALDWIN-HILL COMPANY, 103 Breunig Ave., Trenton 2, N. J.

Please send complete information on

- ☐ POWERHOUSE CEMENT . . . High adhesion, rockwool, insulating-finishing cement
- ☐ BLANKETS . . . Metal-reinforced, flexible, felted, rockwool insulation
- ☐ NO. 1 INSULATING CEMENT . . . All-purpose, rust-inhibiting, plastic cement
- ☐ MONO-BLOCK . . . Rigid, felted rockwool block—for high and low temperature use

More EQUIPMENT NEWS

Begins on page 156

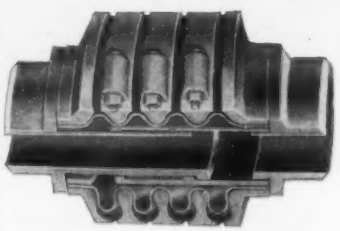


Pulsation Damper

307 • Improved pulsation damper for gauge and governor lines features shorter length and corrosion resistant stainless steel filter. Bodies are all brass for 3000 lb, steel with stainless microvalve for 6000 lb or all stainless for 10,000 lb operating pressure. Valve has 96 to 1 taper to eliminate stem and screw compression strain. When installed ahead of gauge or governor, unit smoothes line flow to eliminate gauge pointer "jitter." Further details available on request to manufacturer.

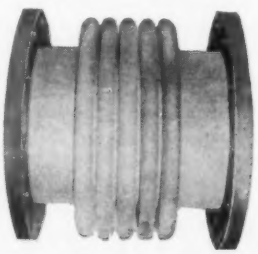
J A Campbell Co, 645 E Wardlow Rd, Long Beach 7, Calif.

For more data on these items, use post cards p 165. Identify your request with item number.



Expansion Joints

345 • Internally guided, packless, corrugated expansion joint provides true longitudinal or axial movement without distortion. Guide sleeves are same ID as piping on which unit is installed. Any type of expansion joint, self-equalizing or non-equalizing, is available with this design.



Expansion joint with close pitch corrugations prevents metal stresses beyond elastic limit over full traverse range. Units will handle pressures ranging from 0 to 50 psig maximum, can absorb up to 5 in. longitudinal or axial movement without use of equalizing rings. They are available in sizes from 2½ in. to 13 ft. Catalog 64 available from manufacturer.

Joseph Kopperman & Sons, 312-16 New St, Philadelphia 6, Pa.

(*Continued on page* 172)

How Correct Lubrication cured them— and saved 37 production hours per week!

SOCONY-VACUUM

SOCONY-VACUUM

Correct Lubrication

FIRST STEP IN CUTTING COSTS

You could almost set your watch by it. At first, everything was normal. Then—slowly, mysteriously—it happened...the "jaws" gradually stiffened, moved more and more erratically, finally froze rigid. "Lockjaw" had set in again!

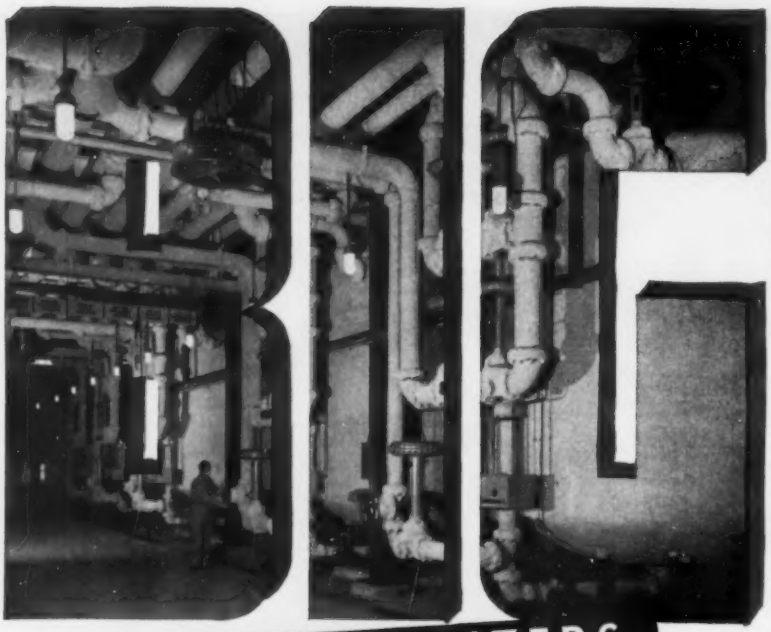
It was happening in a large auto plant. Twice a day five big lathes were shut down for 45 minutes while the chucks—or "jaws"—were cleaned and repacked with fresh grease so that production could continue on crank shaft forgings. All remedies had failed.

A Socony-Vacuum man discovered this situation while making an analysis of the plant. Shocked by this huge waste of time and production, he asked one of his staff engineers to investigate.

This engineer studied the problem, made lab tests, found that cutting coolant, continuously splashing over the chucks, caused the grease to harden. He recommended a special Gargoyle grease —Sovarex #1. It cured the "lockjaw."

This is an actual case. It points up how much you may gain by using *Correct Lubrication*—top-quality products *plus* the world's greatest lubrication knowledge and engineering service. Can you afford to accept anything less?

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION



DEMINERALIZERS

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Nalcite® ION EXCHANGE RESINS

(DOWEX*)

THIS demineralizer, one of the world's largest, provides 100% makeup for 1250 psi boilers generating 1,200,000 pounds of steam per hour. Using Nalco ion exchange resins, Nalcite HCR® and Nalcite SAR, silica is successfully removed from the feedwater — as illustrated by the fact that after 75 to 100 concentrations, silica content of the boiler water is still *less than 5 ppm!*

In demineralizers large or small, Nalcite ion exchange resins give top performance. They are chemically and physically stable for long life at top efficiency. *Two* Nalcite anion exchangers . . . your choice of SAR or SBR . . . are available to meet the conditions of your water supply. Either, used with Nalcite HCR, offers top quality demineralized makeup for high pressure steam generators.

*Reg. Trademark of The Dow Chemical Company.

DATA ON SILICA REMOVAL

A new edition of Nalco Bulletin 57 gives technical data on Nalcite SAR and Nalcite SBR anion exchangers . . . includes complete up-to-the-minute information on silica removal. Write for your copy today.

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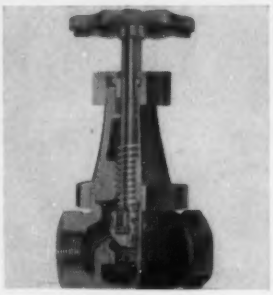
PRODUCTS • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.*

More EQUIPMENT NEWS

Begins on page 156

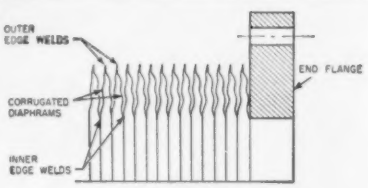


Valves

318 • New and improved version of famous *Ostlind* valve, the *Gyroseal*, eliminates valve failure by causing disc to rotate rapidly at moment of closure. Centrifugal force throws off foreign particles and turbulence keeps them in suspension while disc gently polishes seat. *Gyroseal* valves cut downtime by eliminating leakage, unbalanced flow, spalling, wire drawing, chattering, sticking, etc. Descriptive literature available from manufacturer.

Richmond Fdry & Mfg Co, Richmond, Virginia

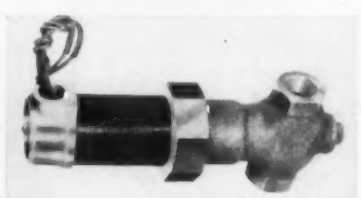
For more data on these items, use post cards p 165. Identify your request with item number.



Metallic Bellows

321 • Welded-diaphragm type metallic bellows are now available in a variety of standard production sizes and in any one of several different metals. Originally developed for atomic energy application, special construction provides long life under severe conditions of corrosion, vibration and high temperature. Units are currently finding wide application as shaft seals, expansion joints and vibration absorbers. Both standard and nesting types of bellows are available in a wide variety of sizes in stainless steel, Monel and Inconel. Full details are presented in manufacturer's bulletin No. 300.

Titeflex, Inc, 500 Frelinghuysen Ave, Newark 5, New Jersey



Solenoid Valves

313 • New line of cast-iron and cast-steel solenoid valves is now available in sizes from ½ to 2 in. Pressure range to 1000 psi at 200 F, 500 psi at 450 F. New engi-

Are Standard Pressures High Enough For You

...or do you need *special* steel valves?

CHAPMAN CAST STEEL VALVES are made in gate, globe, swing and tilting disc check types . . . to handle the most severe high-pressure, high-temperature services. These valves are made to ASA and API ratings in all sizes. And on the special side, Chapman has everything needed to develop alloys and designs for *any* requirement. Do *you* have Catalog 20?

THE CHAPMAN VALVE MFG. CO.
INDIAN ORCHARD, MASSACHUSETTS

YEAR BY YEAR, CHAPMAN WRITES NEW CHAPTERS IN METALLURGY AND FLOW-CONTROL

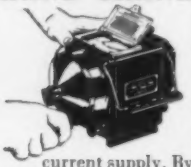
BIDDLE *Instrument News*

MEGGER® ELECTRICAL INSULATION TESTERS

Hand—Rectifier—or Combination Operation—

Ratings up to 2000 Megohms and 1000 Volts D-C

HAND CRANK MEG TYPE

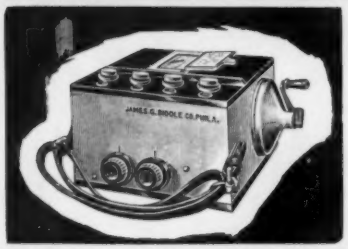


of Megger Insulation Tester is a reliable field instrument, light, sturdy, with a constant-voltage type generator—no dependence on batteries or other current supply. By far the most popular instrument among electrical plant maintenance men. Easy to use—easy to read—and rugged in constant services.

RECTIFIER OPERATED Meg Type of Megger Insulation Tester simply plugs into a convenient outlet. Portable or flush bench-mounted. A dependable production or inspection instrument. Quick, easy readings speed up otherwise costly tests.

DUAL-OPERATED MEG TYPE of Megger Insulation Tester may be operated by hand or rectifier. Excellent solution for those requiring a versatile instrument for field and bench use.

Write for BULLETINS 21-45 P 21-46 P



INSULATION TESTER & WHEATSTONE BRIDGE in ONE EASILY PORTABLE INSTRUMENT

Measures Electrical Resistances From a Fraction of an Ohm up to 1000 Megohms

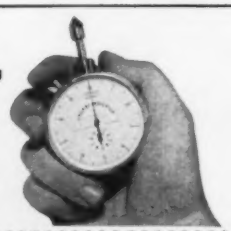
Affords the facility of:

- **A Wheatstone Bridge** for measuring conductor resistance of coils, resistors and circuits.
- **A Megger Direct Reading Ohmmeter** for measuring electrical insulation resistance (ohm and megohm scales).
- **A Varley Loop Feature** for locating faults on wires (optional).

This Bridge-Meg weighs only 15 lbs. and is completely self-contained with its own constant-voltage generator—no need to be dependent on batteries or other suitable test current.

Why burden yourself with two instruments when you can have the facilities of two for little more than the price of one in one compact, sturdy case. For complete details and prices write for BULLETIN 21-60 P.

IF YOU MEASURE SPEED • • • YOUR BEST BET IS BIDDLE



Average Measuring RPM or FPM Jagabi® Speed Indicator

Dr. Horn Tachometer

Jagabi® Tachometer

Instantaneous Speeds or Variations in Speeds. Write for BULLETIN 35-P

Frahm® Resonant Reed Tachometer

Quick Accurate Readings with Safety

BULLETIN 31-P

B-914

JAMES G. BIDDLE CO.

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

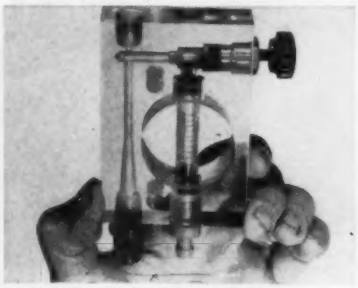
1316 ARCH STREET
PHILADELPHIA 7, PA.

More EQUIPMENT NEWS

Begins on page 156

neering features include stick-free internal design, stainless steel hooded pilot seat screw for more positive closing action and Teflon disks. Full details in Technical Bulletin No. 106.

Atkomatic Valve Co, Dept 258, 545 Abbott St, Indianapolis 25, Ind.



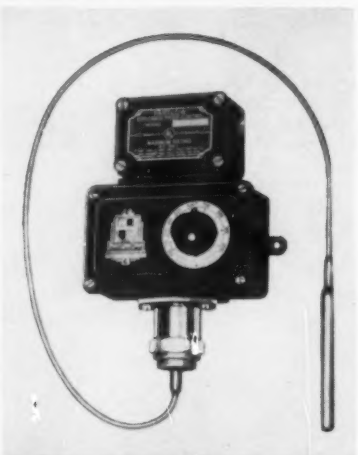
Chemical Feeder

317 • Self-contained, corrosion-resistant chemical feeder is proving highly successful in following services: hypochlorination of water, addition of algicides to reservoir water, treatment of slime control, addition of anti-foaming agents, rust and scale inhibitors in pipes and boilers, feeding of detergents into wash water.

Rugged and compact, this unit simultaneously meters, controls, mixes and dispenses small proportions of liquid chemicals into liquid streams. Unit comes in four standard models with reagent capacities ranging from .03-0.3 to 2-20 gph. Full details available on request to manufacturer.

Fischer & Porter Co, 19 Jacksonville Rd, Hatboro, Pa.

For more data on these items, use post cards p 165. Identify your request with item number.



Explosion-Proof Temperature Control

336 • New compact explosion-proof non-indicating temperature control is suitable for use in many hazardous locations. Unit measures 6½x6½x3¼ in., weighs 4½ lb. It is especially suited to the control of all types of appliances where constant visual

here's how high temperature piping can flex its muscles

Each pipe hanger is scale tested to rigid tolerances by a skilled workman at the Navco plant. After final assembly and inspection, the hangers are carefully crated and readied for shipment.

NAVCO *Counterpoise* Pipe Hangers

Since high temperature piping has no respect for equipment connections, the entire piping system must flex its muscles to absorb the strain of expansion and contraction. This prevents serious stresses that could endanger the installation.

And how does high temperature piping flex its muscles? With Navco's precision engineered Counterpoise Pipe Hanger—the hanger with a load-supporting effort that is of constant value throughout the range of travel. This permits weightless movement of the entire piping system.

To learn how power plants, oil refineries and chemical plants can have piping systems that flex their muscles, write today for Navco's 12-page Counterpoise hanger bulletin #153.

NAVCO

NATIONAL VALVE & MANUFACTURING COMPANY

3105 LIBERTY AVENUE, PITTSBURGH 1, PENNSYLVANIA

New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati

DUAL CONTROL means ECONOMY

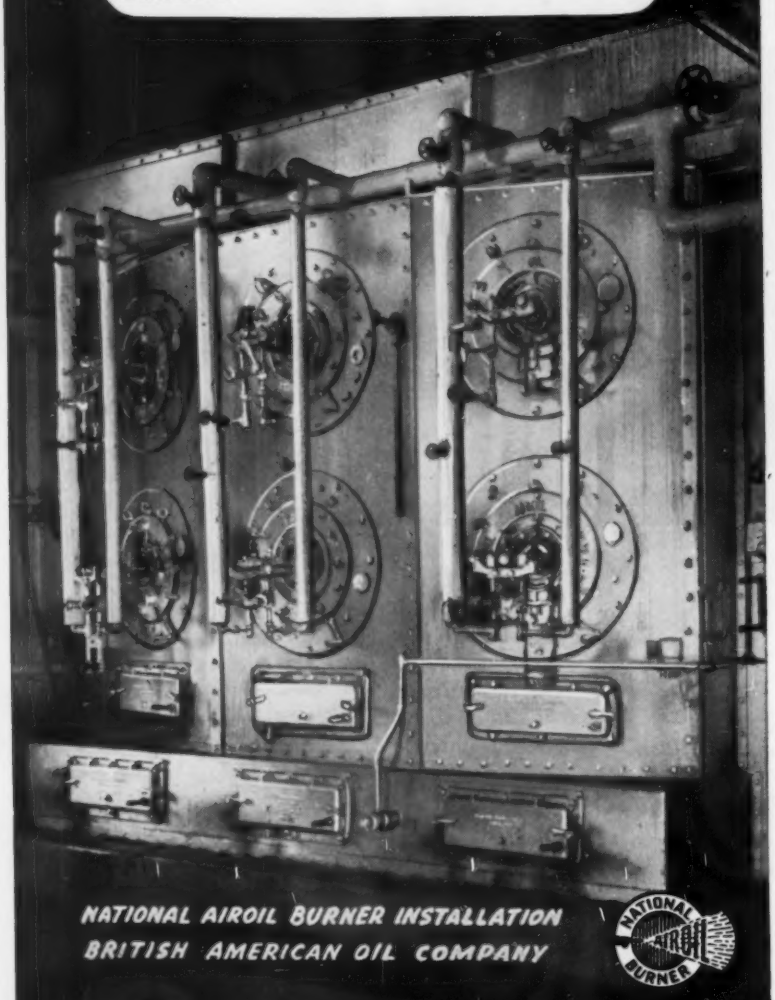
with NATIONAL AIROIL Universal Registers

AND TYPE "S-A-L" OIL BURNERS

. . . and economy means that you get better performance with NATIONAL AIROIL Universal Registers because they have a dual feature for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disk control. Both adjustments can be made while the Type "S-A-L" Oil Burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil.

Universal Registers with Type "S-A-L" Burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.



NATIONAL AIROIL BURNER INSTALLATION
BRITISH AMERICAN OIL COMPANY

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 156

evidence of temperature is not required. Mercury actuated, *Model VS* is available with any of ten elements covering temperature range from –30 to 1200 F. Unit is UL-approved for use in following atmospheres: Class I—Group C and D, Class II —Group E, F and G. Further information available from manufacturer.

Partlow Corp, New Hartford, N. Y.

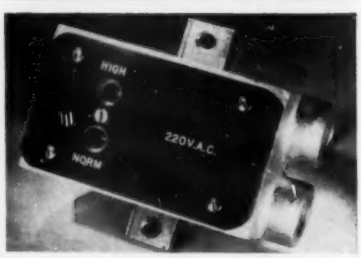
Heavy Duty Limit Switch

305 • *Loxswitch*, a new heavy duty limit switch, offers outstanding electrical, mechanical and maintenance features. Unit is interchangeable with most existing installations and original equipment designs.

Device is a single-pole-throw double-break switch with a unique trigger-type mechanism that provides unusually fast and accurate action. Repetitive accuracy is within .03 degrees, maintained without necessity for lubrication. Wiring terminals are enclosed in a large compartment completely separated from all moving parts. Further details are available in manufacturer's bulletin LS53A.

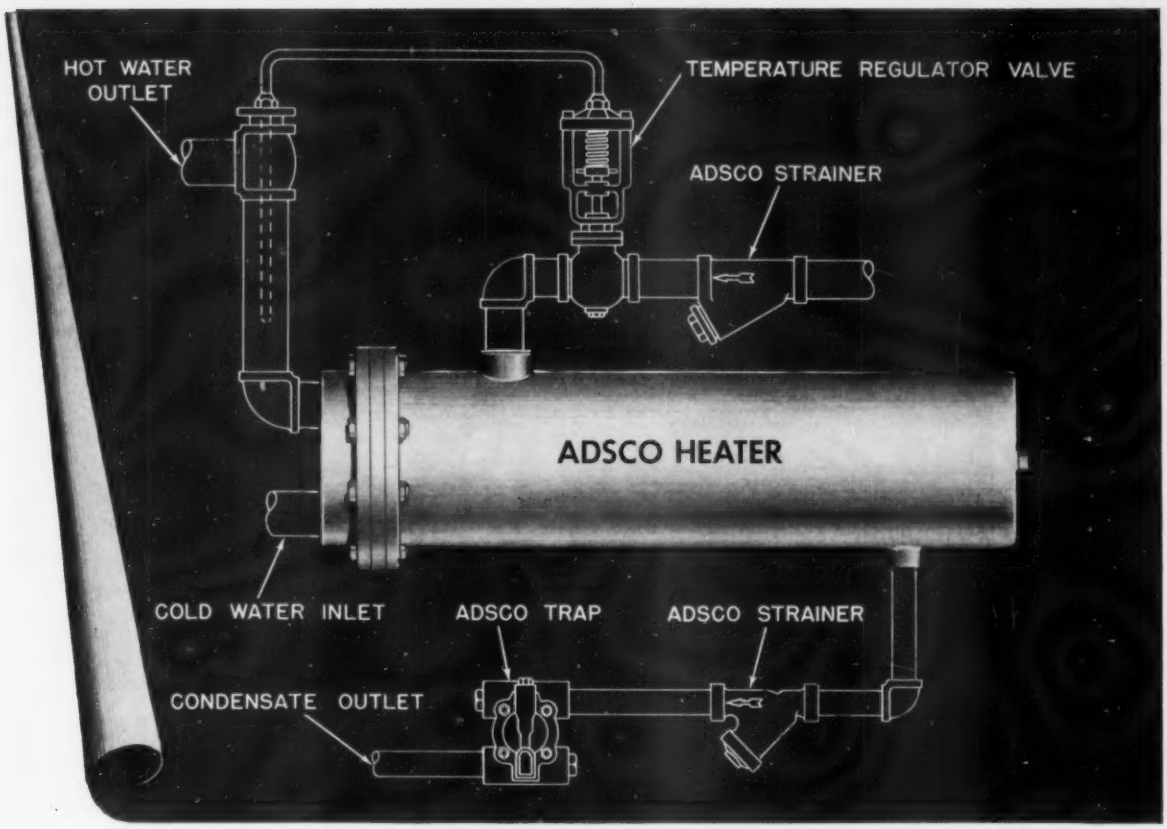
R B Denison Mfg Co, 4220 Hough Ave, Cleveland 3, Ohio

For more data on these items, use post cards p 165. Identify your request with item number.



Voltage Indicator

315 • Inexpensive high-low voltage indicator designed for use with portable or stationary industrial equipment is specifically suited to machinery whose efficiency depends upon a certain voltage range. Model 961 indicates a low of 95 to 105 v, high of 130 to 140 v. Model 960 indicates low of



BLUEPRINT FOR ACTION!

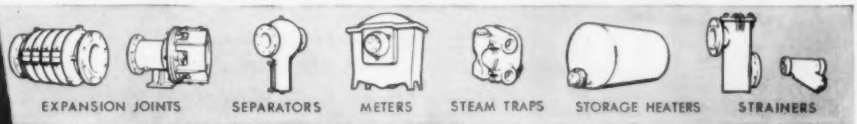
And what action, when you use an ADSCO Water Heater! Hot water . . . when and where you want it . . . and at low cost! ADSCO Instantaneous Heaters furnish industry with general service hot water, boiler feed water, and process water. They supply hotels, apartments, office buildings, dormitories, hospitals, and institutions with hot water for showers, washrooms, dishwashers, laundries, and for general cleaning. ADSCO Convertors, a type of instantaneous heater with a shorter temperature range, furnish *all types* of buildings with hot water for quiet, trouble-free space heating systems.

Yes, you get plenty of action — fast action — out of ADSCO Water Heaters. They operate best when connected according to the typical piping arrangement shown above, with two ADSCO Y-type Strainers to protect valuable equipment and an ADSCO Dual Steam Trap to handle condensate efficiently.

ADSCO Water Heaters have only three parts: shell, tube bundle, and cover. All are made to ADSCO's high standards. Steel shells are seamless steel pipe, carefully cut and welded by skilled workmen. The shell flange is sturdy and accurately machined and all openings are precisely located. The tube bundles are made of pure, deoxidized seamless copper tubes formed into U-bends. By means of electrically and automatically controlled equipment, they are rolled and expanded into carefully drilled tube sheets which have a diamond pitch arrangement for spacing of tubes. The semi-steel covers are high-tensile, fine-grain castings.

For further information, write for Bulletin 35-78 on Instantaneous Heaters or Bulletin 35-77 on Convertors.

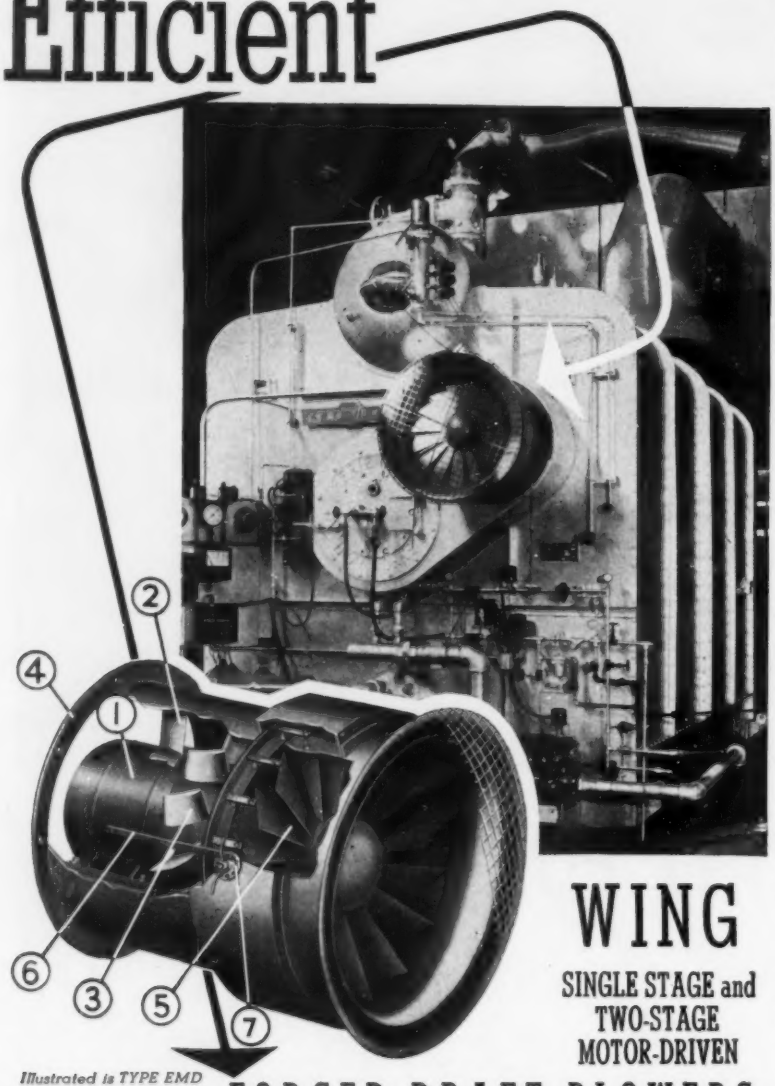
ADSCO ENGINEERED PRODUCTS



AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK
PLANTS: NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

Efficient



Illustrated is TYPE EMD Single Stage Blower (1) Fully enclosed motor. (2) Air straightening vanes. (3) Axial flow airfoil fan wheel mounted directly on motor shaft. (4) Blower mounted at this flange—no other support needed. (5) Voltrol Vanes. (6) Lever for capacity regulation. (7) Voltrol vane control mechanism.

WING

SINGLE STAGE and TWO-STAGE MOTOR-DRIVEN

FORCED DRAFT BLOWERS

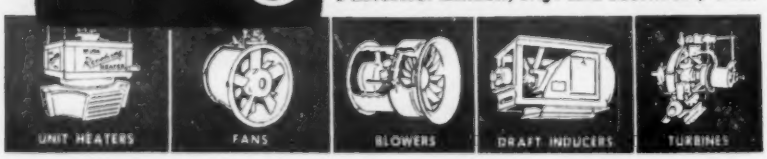
WING Motor-Driven, Forced Draft Blowers are the result of years of pioneering with the airfoil design of the axial-flow fan. Each part of the Wing Blower is made to produce and control the air flow into the furnace for *maximum* firing efficiency. Sturdy construction, compact design, quiet performance, Voltrol Vanes, (permitting capacity regulation down to 10% of max.) plus low installation cost—are features of Wing Motor-Driven Blowers. Write for Bulletin SW-1a.

Wing

L. J. Wing Mfg. Co.

50 Vreeland Mills Road
Linden, New Jersey

Factories: Linden, N.J. and Montreal, Can.

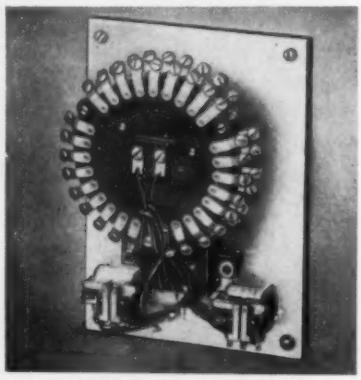


More EQUIPMENT NEWS

Begins on page 156

190 to 210, high of 235 to 255. Unit is available for other voltage ranges on special order.

Industrial Devices, Inc, Edgewater, N. J.

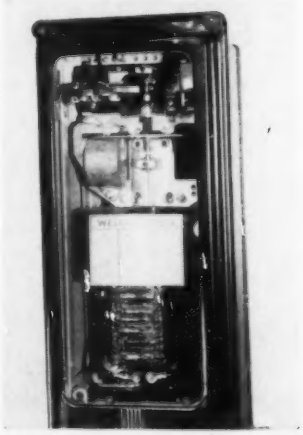


Motor-driven Switch

352 • New motor-driven master switch is a 24-v, 25-circuit unit with each of the 25 circuits capable of operating one remote-control relay that controls one lighting circuit. Driving mechanism is energized by standard low-voltage remote-control switches that can be installed to control the motor-driven switch from as many different locations as desired. Units may be installed in parallel or cascaded. For example, the 25 circuits on one switch may be connected to 25 other switches to achieve control of 625 lighting circuits and so on until all lighting circuits desired are controlled. Unit is rated 3 a, 25 v. Further details available from manufacturer.

General Electric Co, Schenectady 5, New York

For more data on these items, use post cards p 165. Identify your request with item number.



Generator Relay

316 • New negative-sequence overcurrent relay, type COQ, for protection of large generators, initiates action to remove generator from faulted line when damaging effect of negative-sequence current approaches maximum allowed. Unit is available in

DETROIT ROTOGRATE

REDUCES COAL COST

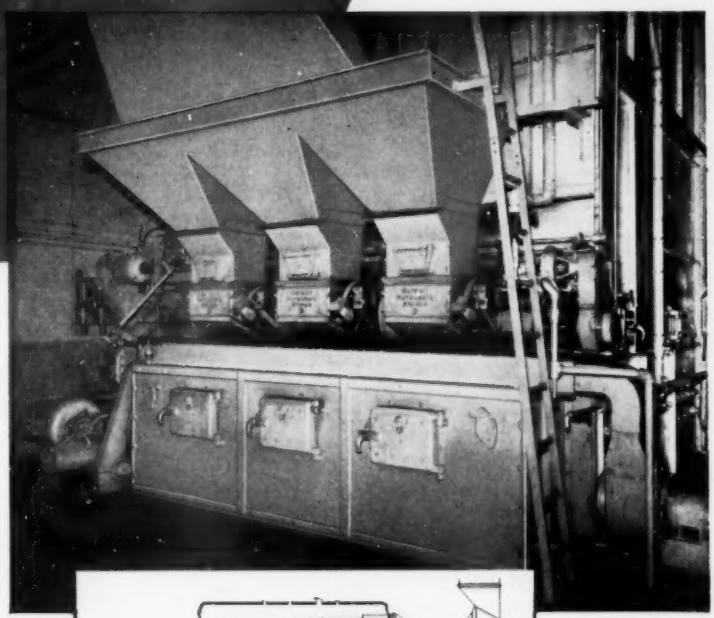
12.6 CENTS PER 1000 POUNDS OF STEAM

AT

Certain-teed Products Corporation

York Pennsylvania Plant

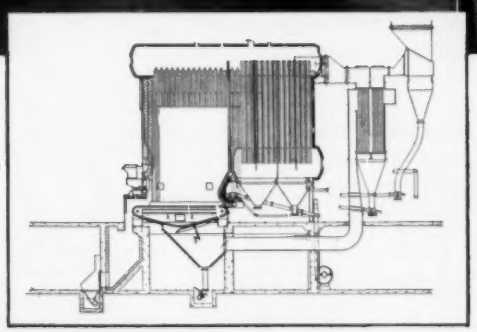
Also Capacity Increased By 479 Tons of Product



Detroit RotoGrate Stoker with Erie City Type VL Boiler at Certain-teed Products Corporation, York, Pa. Capacity 45,000 pounds steam per hour. Operates with preheated air.

THIS Detroit RotoGrate Stoker fired unit has reduced fuel cost 12.6c per thousand pounds of steam at Certain-teed Products Corporation plant at York, Penna., according to report by Mr. W. M. Noon, Combustion Engineer. The reduction in steam cost was made at the same time plant capacity was increased.

The Detroit RotoGrate will save you money and improve your operation. It is the original spreader stoker with forward moving grates that discharge the ash at the front. It handles fluctuating as well as steady loads with high thermal efficiency. • You too can save money with Detroit Stokers. Write for Bulletin.



DETROIT SINCE 1898 STOKERS

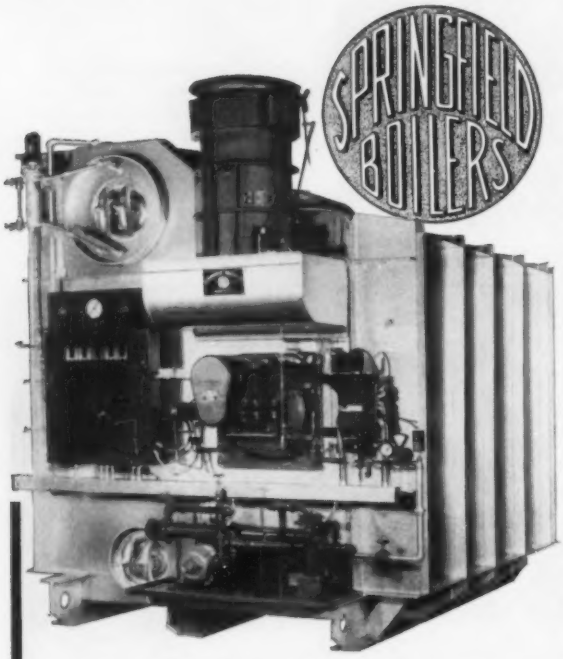
DETROIT STOKER COMPANY

General Motors Building—Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Michigan

Ahead in Design! SPRINGFIELD

WATER TUBE PACKAGE BOILERS



1. Rugged 2-Drum, Bent Tube "*Power Plant Type*" design. No headers, no handholes, no wasted weight. Unrestricted circulation.

2. Complete "6 wall" furnace cooling for greatest capacity. Permits higher heat release rates with lower actual "heat loading" of tubes.

3. Dry Steam — steaming tubes discharge above top drum water level.

4. Exclusive gas-tight, insulated, double-cased steel jacket. Sectional construction makes all tubes easily accessible and replaceable without necessity of tearing out and repairing side wall setting.

5. Pressurized firing. No induced draft fan or tall stack required. Indoor or outdoor installation.

6. Efficiency — over 81% with oil. Automatic, semi-automatic, or manual control. Gas, oil, or combination firing. Underwriters' approved.

7. Widest choice of sizes. All compact, portable. Design pressures of 200, 300, 600, and 900 psig. Superheat to 200° available.

QUICKER, EASIER INSTALLATION!

When you compare quotations for package boilers, check all of the *additional values* Springfield gives you! Make sure you are getting a COMPLETE UNIT ready to connect to fuel, water, electrical, and steam lines — with *no extras* required for setting and other materials.

Springfield Package Boilers are unique in that the basic design is actually the same as a large power plant boiler — consequently, they can be built for as high as 900 psig. operating pressure. These units are also excellent for generation of high pressure — high temperature hot water. *Send for complete information.*

12 DIFFERENT SIZES

6,000 12,000 18,000 24,000 30,000 36,000

9,000 15,000 21,000 27,000 33,000 39,000

POUNDS OF STEAM PER HOUR Guaranteed Capacity

SPRINGFIELD BOILER CO.

Founded in 1890

A DIVISION OF *John W. Hobbs Corporation*

1911 East Capitol Avenue • Springfield, Illinois

Ask for Latest Catalog

More EQUIPMENT NEWS

Begins on page 156

Flexitest projection or semi-flush case and in standard rectangular glass projection case. Full design and operational details available on request to manufacturer.

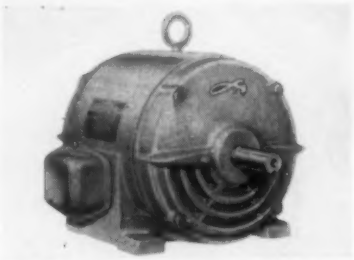
Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Wire Stripping Tool

314 • New improved wire stripping tool features interchangeable cutters for stripping 12 to 24 gauge solid or stranded wire, or 300-ohm twin lead-in wire. Unit is extra lightweight, has lock-pen feature that holds jaws open so wire can be removed after stripping without crushing. Finger tip touch on lower handle releases jaws instantly, makes it unnecessary to shift grip on tool while resetting.

Rockford Wire Stripper Co, Rockford, Ill.

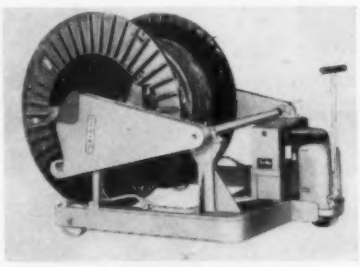
For more data on these items, use post cards p 165. Identify your request with item number.



Explosion-proof Motors

309 • Completely redesigned line of electric motors meets new NEMA rating standards and is available in all standard enclosures: open, drip-proof, totally-enclosed, fan-cooled and explosion-proof. Manufacturer claims new units have been reduced in size and weight yet outperform older models in every way. Full details on redesign and construction innovations available on request.

Louis Allis Co, Milwaukee 7, Wis.

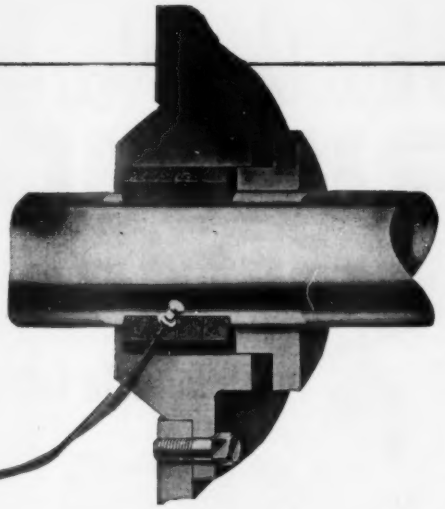


Reel Handling Truck

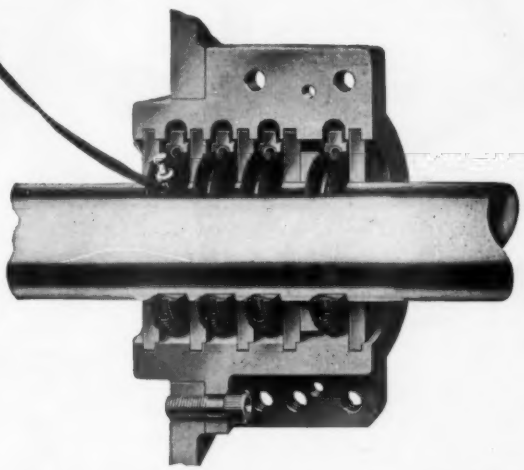
330 • New reel handling truck features capacity of 16,000 lb, maximum lift of 14

COPPUS TURBINES

offer you a choice of packing rings



STANDARD METALLIC RING PACKING — Made of high grade asbestos cores encased in specially treated lubricated aluminum foil. Recommended as a low-friction, long-service packing for steam temperatures up to 850 F and back pressures up to 50 lb. Adjustable packing glands keep leakage at minimum. Easy access to packing rings.



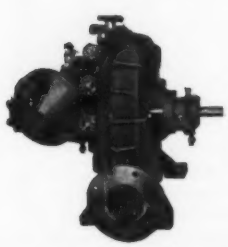
OPTIONAL CARBON RING PACKING — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

Heavy chrome plating on shaft at stuffing box is common to both types of Coppus packing.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

FIT TURBINE COSTS TO HORSEPOWER NEEDS

When you buy turbines rated close to your exact horsepower needs, you save plenty of money. That's because turbines are generally priced in proportion to their size. The wide range of sizes of Coppus Turbines promises purchasing economy for you from the 150 hp size down to the smallest. As for operating and maintenance economies, you get them, too, from such other features as: greater number of manually operated valves for individual control of steam nozzles; replaceable cartridge-type bearing housings and others. For complete details . . .



WRITE FOR BULLETIN 135
COPPUS ENGINEERING CORPORATION
163 Park Avenue
Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

Look...the New 40A RIDGID Tristand

with built-in folding tray

Tray pushes up easily to fold Tristand, pushes down easily to set up. Holds stand rigid.

Vise base overhangs front legs so threader handles swing clear. Perfect tripod and balance.

Folds up small as ever for easy carrying to job and it's extra lightweight.

The Tristand you've been wanting. Now stand and tray all one unit—no loose parts. Extra-light weight, stronger more rigid than ever. Full size vise base—3 benders, ceiling brace screw, pipe rest, new tool-hanging slots. Designed for the utmost service for your money. See the new RIDGID 40 A Tristand at your Supply House! Immediate deliveries!

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U.S.A.

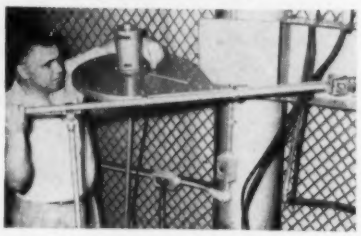
RIDGID
Work-Saver Pipe Tools

More EQUIPMENT NEWS

Begins on page 156

inches. It will handle rolls up to 84-in. diameter. Overall size of truck shown is 6x6 ft, but trucks can be made to specifications depending on size of reel to be handled. Powered by 18-v battery, this unit has roller grip controllers and push-button hydraulic lift system. Travel speed is 2½ to 3 mph with two speeds forward and reverse. Further details from manufacturer.

Moto-Truc Co, 1919 E 59th St, Cleveland 3, Ohio



Cable Puller

334 • New power tool for conduit jobs can be operated in any position for either pushing or pulling purposes. This portable unit pushes 25 ft of fish taper per minute around five 90° bends, stops automatically if conduit is blocked and can pull 15 ft of wire per minute into ¾ to 2-in. conduit. Machine provides 175 ft of .060x¼-in. usable tape, operates on 115 v ac or dc and pulls 1200 lb dead weight. Entire unit weighs 65 lb. Further details available.

Barth Corp, 12650 Brookpark Rd, Cleveland 29, Ohio

For more data on these items, use post cards p 165. Identify your request with item number.

Soldering Guns

329 • Restyled and improved soldering gun now uses increased power up to 275 watts. This extremely versatile tool combines adequate heating capacity with accurate fingertip control. Exclusive tip fastening arrangement assures full constant heat by eliminating contact resistance and oxidation. Two new industrial models are available: single-heat 250 watt or dual-heat 200-275 watt. Full details available on request to manufacturer.

Weller Electric Corp, 808 Packer St, Easton, Pennsylvania

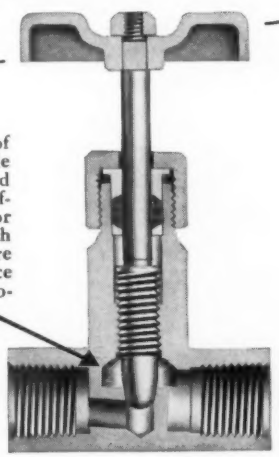
Integral Hp Motors

353 • New line of integral hp motors will conform to 1954 NEMA standards but at same time will offer users present or new

(*Continued on page* 188)

MAXIMUM WORKING PRESSURE
10,000 PSI
for water, oil or gas

- Body and stem guide extra heavy bar stock fused into one piece.
- Valve stem 416 stainless steel.
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.



ONE PIECE

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.

Introducing-

The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

Write today for catalog giving complete details.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

Dept. F, Skokie, Ill.
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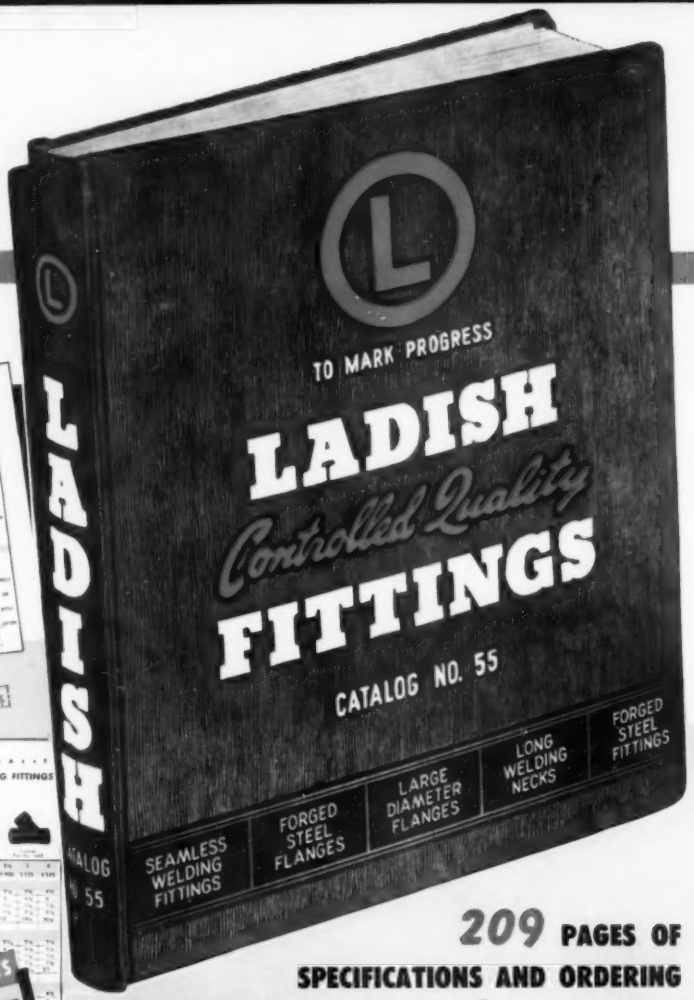
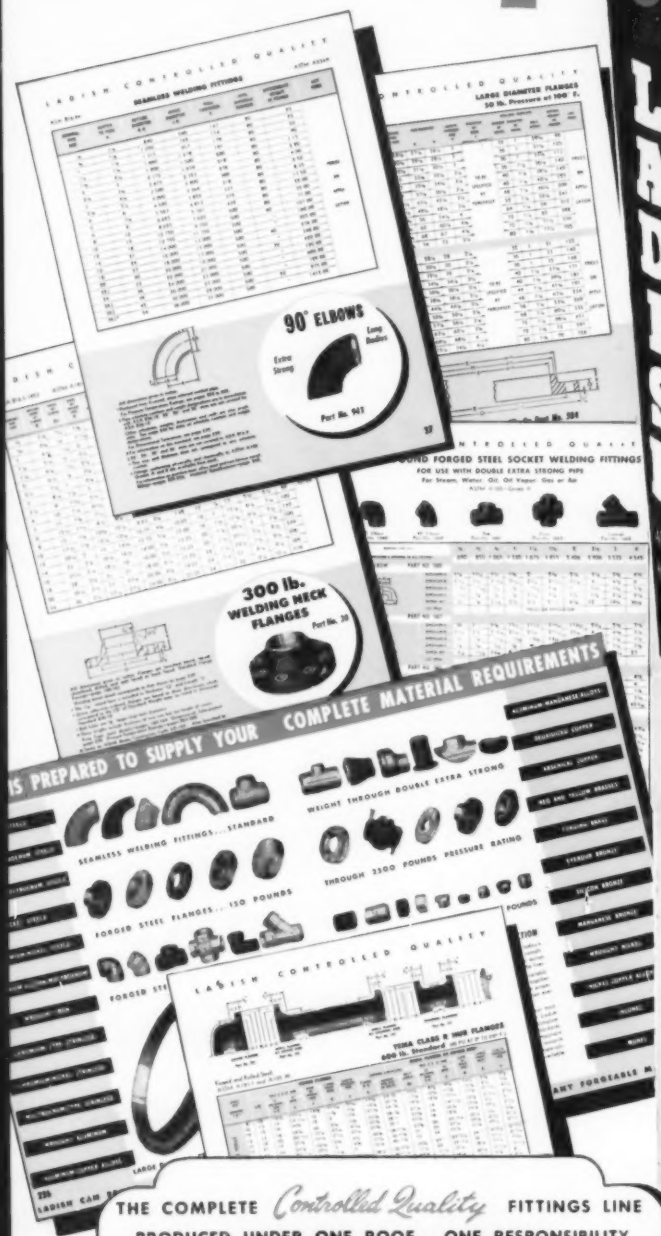
MARSH

"THE STANDARD OF ACCURACY"

SEND FOR YOUR NEW

304-PAGE LADISH FITTINGS CATALOG NOW





209 PAGES OF SPECIFICATIONS AND ORDERING INFORMATION ON *Controlled Quality* FITTINGS

Here are detailed dimensions, weights and specifications to assist in selecting proper fittings for any application. Featured are a number of Ladish developments which improve piping efficiency. Major product listings by sections include:

68 PAGES BUTT WELDING FITTINGS
Available in Standard through Double Extra Strong weights... in sizes ½ through 42 inches.

56 PAGES FORGED STEEL A.S.A. FLANGES
Available in 150 through 2500-pound pressure ratings ...in sizes ½ through 24 inches.

20 PAGES LARGE O.D. AND T.E.M.A. FLANGES
Available in a complete range of types and pressure ratings... in sizes up to 160 inches in diameter.

7 PAGES LONG WELDING NECK FLANGES
Available in 150 through 2500-pound pressure ratings ...in sizes from 1 through 24 inches.

5 PAGES FORGED WELDLESS ROLLED RINGS
Available in diameters up to 240 inches in a wide variety of forged contours...in weights up to 40,000 pounds.

20 PAGES FORGED STEEL FITTINGS
Screwed and Socket-Welding types in 2000 through 6000-pound pressures, sizes ⅛ through 4 inches.

12 PAGES STAINLESS AND ALLOY FITTINGS
Featuring data on properties of materials and a comprehensive table of piping specifications.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF...ONE RESPONSIBILITY

LADISH CO.

CUDAHY, WISCONSIN
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District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.

New LADISH *Catalog*

Provides detailed specifications on complete fittings line plus useful technical data to help solve piping problems

New from cover to cover and thoroughly up to date in latest provisions of codes and standards—this catalog presents a line broad and completely integrated in types, sizes, ratings and materials.

Easy to use . . . for it is fully tabbed with each section having its own pictorial index and table of contents. Durably bound, this book is a reference work on forged and seamless welding pipe fittings and flanges.

56 PAGES OF TECHNICAL DATA WITH LATEST CODE PROVISIONS SIMPLIFY DESIGN PROBLEMS

For busy engineers here are tabulations of pre-calculated values derived from frequently used design formulae which can be applied directly to the solution of piping problems with a minimum of computations. In addition to data on dimensional tolerances, friction loss and material specifications, this section contains valuable tables on:

ALLOWABLE STRESS AND P/S VALUES

Presented here in an easy to use form, these values help solve problems of wall thickness and working pressures in gas, power, district heating, refrigeration, oil transmission and refinery piping.

MAXIMUM WORKING PRESSURES

Tabulations for ½ through 30-inch pipe in a wide selection of wall thicknesses and materials for operating temperatures from 100° F. through 1500° F., in power, district heating, oil transmission, refinery and gas piping systems.

FLANGE PRESSURE-TEMPERATURE RATINGS

Tabulations feature new ratings for a wide range of materials for temperatures from 100° F. through 1500° F.

PROPERTIES OF PIPE

Dimensional characteristics of carbon, alloy and stainless steel pipe in commonly used nominal sizes and wall thicknesses to help solve problems of anchorage, heat loss and insulation.

FLOW THROUGH ORIFICES AND NOZZLES

Discharge through orifices, nozzles and short tubes are tabulated for a wide range of pressures up to 5000 P.S.I. and diameters from 1/64 through 1¼ inches.

LADISH CONTROLLED QUALITY
Pressure-Temperature Ratings for Ladish Forged Carbon and Alloy Steel Pipe Flanges
LADISH CONTROLLED QUALITY
Table of PROPERTIES of PIPE (Cont.)
LADISH CONTROLLED QUALITY
FLOW THROUGH ORIFICES, NOZZLES AND SHORT TUBES
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OIL TRANSMISSION LINES OUTSIDE CITY OR VILLAGE LIMITS
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Dept. PO, Cudahy, Wisconsin

Please send me, without cost or obligation, the new 304-page Ladish Fittings Catalog No. 55.

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Title

Company

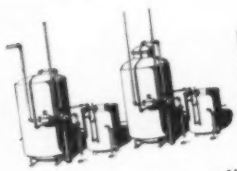
Address

City Zone State

ELGIN-REFINITE

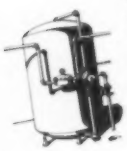
Just a hyphen, *but it marks...*

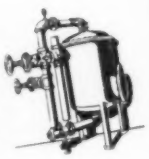
...today's greatest advance in Water Conditioning



Ion Exchange Equipment

From sodium zeolite to complete deionization and silica removal, the Elgin-Refinite line is complete: The famous "Double-Check" zeolite softener . . . zeolite-alkalinity neutralization . . . split stream sodium and hydrogen zeolite softening with degasification . . . the Ultra-DeIonizer providing distilled water quality at a fraction of the cost.

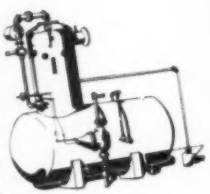




Filtration in all phases

Diatomite filters . . . sand filters . . . activated carbon filters . . . anthrafilt filters for every use ranging from municipal water works and swimming pools to oil removal and many other applications.

Aeration, Degasification, and Deaeration



All types of equipment for removal of dissolved and entrained gases from water through degasification and aeration. A big efficiency gain is made by deaerating heaters which supply make-up water, preheated by exhaust steam, in which carbon dioxide is eliminated and oxygen is reduced to less than 0.005 cc per liter.

Lime-Soda, Coagulation, and Clarification

Whether it's simple clarification, cold lime soda or hot lime soda, Elgin-Refinite has the efficient answer. Hot lime followed by zeolite eliminates excess chemical dosage or after-treatment regardless of operating variations. Packaged and specially engineered equipment.

No other plant operating problem involves quite so many ifs, ands, and buts as water conditioning. Because raw waters are so varied—because "finished" water needs are equally varied—the water conditioning methods that are a howling success in one plant can be a dismal failure in another.

Too many operating men have learned this the hard way; and that is why your water conditioning problem should be placed only in the hands of an organization that measures up to these two vital requirements:

1. Maximum experience with *all* waters and *all* water requirements.
2. Not only good equipment, but *all types* of good equipment and methods from which an unprejudiced selection can be made to meet your specific water conditioning needs.

These difficult requirements were fulfilled as never before when Elgin and Refinite joined forces in October 1953. Each organization had a wide line of equipment; but together their scope is unlimited. Each was old established; but together they represent 83 years of intensive experience.

It is impossible to show in limited space the unequalled range of Elgin-Refinite services. But note that we do briefly outline opposite how much more Elgin-Refinite has to offer in the four basic categories of water conditioning. This combined experience and scope is your assurance that your water conditioning problem will be solved in the most versatile, dependable, economical way by Elgin-Refinite!

ELGIN-REFINITE

Division of Elgin Softener Corporation, ELGIN, ILLINOIS

Representatives in principal cities

Elgin REFINITE SINCE 1908

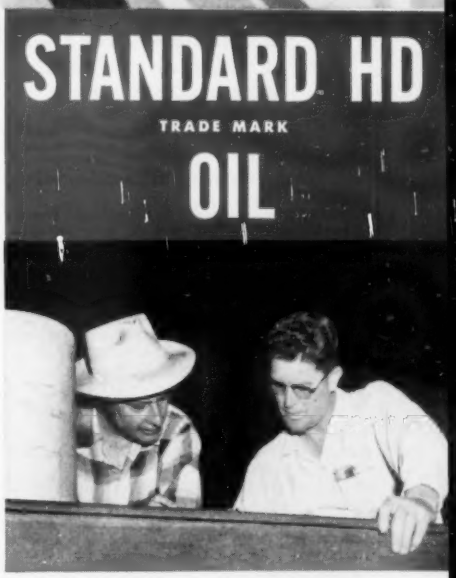
In Canada:
G. F. Sterne & Sons
Brantford

New diesels get same "lube diet" that kept old units healthy...

For many years, the Las Animas Municipal Power and Light Company kept its original diesel equipment operating at remarkably low cost. Using Standard diesel oils, down time and maintenance were negligible in spite of greatly increased loads that forced the units far beyond their rated capacities.

In 1951, when two new 1750 hp. Nordbergs were installed in the Las Animas, Colorado, power plant, it was natural for plant officials to select STANDARD HD Diesel Oil on the basis of this outstanding past performance.

Used exclusively in the new units, STANDARD HD has set a new high for healthy performance. In over two years of continuous hard service, STANDARD HD has supplied clean, protective lubrication. After 6000 hours of operation wear was so slight that it could not be measured; engines are kept clean constantly in all working parts.



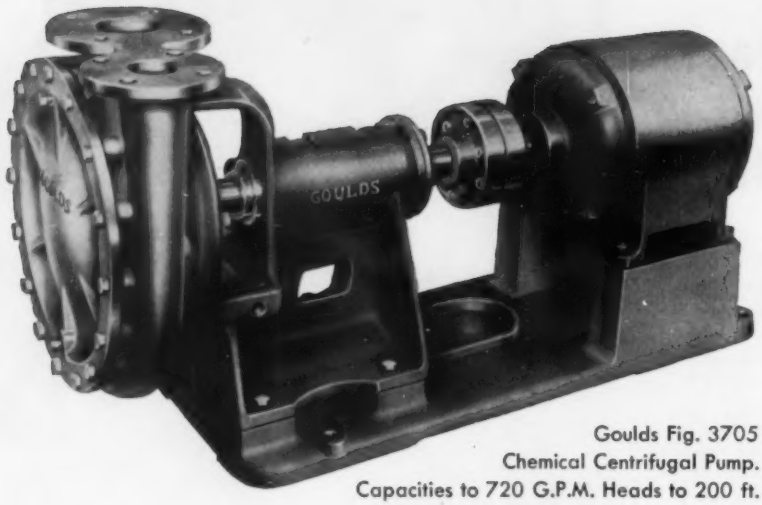
Ralph Barbee, plant superintendent of the Las Animas Municipal Power and Light Company, checks the operating log with E. C. Jeffries, Standard Oil lubrication specialist.

• Diesel plant operators throughout the Midwest have discovered they can count on low cost diesel operation when they use STANDARD HD Oil. STANDARD HD provides an economical solution for costly maintenance problems—ring sticking and breaking, carbon deposits, cylinder wear—because STANDARD HD Oil lubricates, cleans *and* protects.

A Standard Oil lubrication specialist stationed near your plant throughout the Midwest can help you secure successful results in the operation and maintenance of your diesels. For his services, call your local Standard Oil Company office. Or write: Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD



Goulds Fig. 3705
Chemical Centrifugal Pump.
Capacities to 720 G.P.M. Heads to 200 ft.

Now available in these **8 different materials!**

You know the Goulds Fig. 3705 as the pump that is saving chemical plants thousands of dollars in handling corrosive liquids such as acids and alkaline liquors.

You've asked if it could be supplied in materials other than stainless steel 316 and FA-20. Here's the answer:

You can now take your choice of these eight different materials:

1. Stainless steel 316
2. Stainless steel FA-20
3. Stainless steel 304
4. All iron
5. All bronze
6. Bronze fitted
7. All iron, stainless steel trim
8. All bronze, stainless steel trim

And you can take advantage of these four saving benefits:

a. **Long packing life and freedom from leakage**—Stuffing box on suction side of impeller means pressure is limited to suction head.

b. **Easy cleaning and inspection**—Suction and discharge connections in casing permit removal of casing cover and impeller without disturbing piping.

c. **Impeller clearance adjustable for wear**—By loosening and sliding end cap along shaft you expose locking collar on outboard ball bearing, permitting you to readily adjust impeller position.

d. **Low parts inventory** — Interchangeable parts permit you to keep inventories down and prevent excessive down-time.

To get full information on these new materials, plus performance curves, specifications and dimensions, contact your nearby Goulds representative, or clip and mail the coupon for new Bulletin 725.3.

Goulds PUMPS INC. Seneca Falls New York

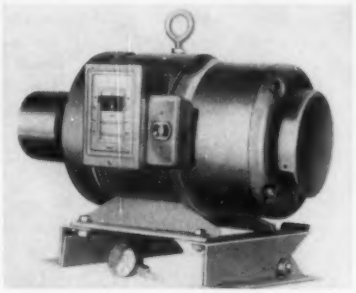
GOULDS PUMPS, INC.
Dept. PO, Seneca Falls, N. Y.
Please send me Bulletin 725.3.
Name_____ Title_____
Company_____
Address_____
City_____ Zone___ State____

More EQUIPMENT NEWS

Begins on page 156

mountings. This promises to be a considerable saving to the customer who, during the transition period, can avoid cost of remodelling machines and can liquidate inventories of belts, pulleys and accessories without loss. First production will include 203, 213, 225 and 215 NEMA frames with all standard hp ratings in these sizes. Further information available from manufacturer.

A O Smith Corp, Electric Motor Div, Milwaukee 1, Wisconsin

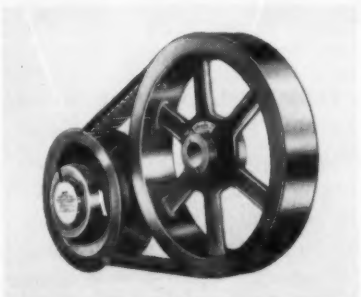


Tractor-Drive Generator

354 • New generator designed for belt-drive, produces highline type electricity for low cost emergency power when commercial supply stops. Available in 3, 4, 7 and 10-thousand-watt capacities, units supply exactly the same 115/230 v, 60-cycle ac delivered by commercial lines. Easy to set up, generator connects simply both electrically and mechanically and can be ready to operate within minutes. Further details in manufacturer's Form A269.

D W Onan & Sons, Inc, Minneapolis, Minnesota

For more data on these items, use post cards p 165. Identify your request with item number.



Variable Speed Drive

333 • New variable speed drive unit incorporates many exclusive features not found in similar units: greater speed range, simple construction, positive locking, higher efficiency, less shaft overhang, double-end adjustment, no lubrication and increased economy. Details available in manufacturer's bulletin 796.

T B Woods Co, Chambersburg, Pa.

Adjustable V-Belts

355 • New *Veelos* adjustable V-belt for D and E drives features outstanding ease

3 Cooling TOWER DRIVES by PHILLIE GEAR®

a type and size for every requirement

The growing use of larger fans in cooling tower service brought the need for a drive that would best meet heavier load conditions. Philadelphia, having long been a leading manufacturer of conventional worm gear cooling tower drives, thoroughly understood this problem and presents a complete line of right angle Speed Reducers . . . Worm Gear, Spiral Bevel, and Helical Spiral Bevel. All three types are specifically manufactured for cooling tower fan drives. Housings are made of high quality close-grained grey iron and are proportioned to withstand the severe stresses encountered during operation. All shafts mounted in anti-friction bearings to assure high efficiency, correct center distance and proper shaft alignment. Bearings provide generous thrust and radial capacity . . . all these features give long, quiet service life.

worm gear

HP range—3 thru 30 HP @ 1750 rpm input.

Ratio range—3⅝ to 8¾.

Efficiency—up to 95% depending on ratio.

Application—Best economy in range up to 25 HP. Quiet operation, suitable for input speeds up to 2000 rpm.

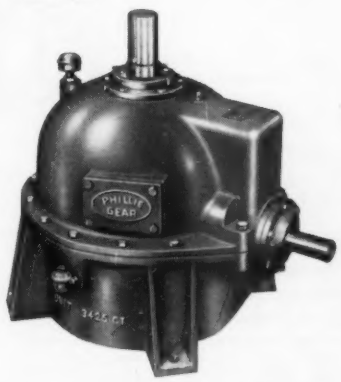
spiral bevel

HP range—15 thru 75 HP @ 1750 rpm input.

Ratio range—3½ to 9⅕:1.

Efficiency—97-98%.

Application—Best economy above 15 HP. Advantages of high efficiency, small heat loss. Suitable for input speeds up to 2500 rpm.



helical spiral bevel

HP range—20 thru 115 HP @ 1750 rpm input.

Ratio range—6⅔ to 15:1.

Efficiency—95-96%.

Application—Best economy when used on drives greater than 25 HP and when required ratios exceed those possible with single reduction spiral bevel. This unit also best suited for turbine applications up to 4000 rpm input.

Write for our new catalog CT-53 illustrating all types of Cooling Tower gear drives and their applications.

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

Choose WESTERN
for Chemical Treatment of Water, Steam and Fuel

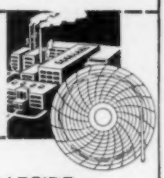
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

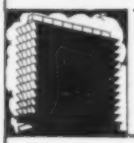
1 *Steam* + CORAVOL® = *Protection* (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





3 COOLING WATER TREATMENT AND ALGAECIDE

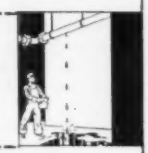
Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

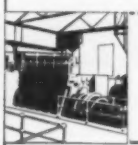
4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.





6 WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

8 WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

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Send me full information about products checked.

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City _____ Zone _____ State _____

More EQUIPMENT NEWS

Begins on page 156

of coupling. Two types are available: regular rubber-coated for general service and oilproof for oily and high temperature drives. Coal pulverizers, compressors, fans and blowers are typical illustrations of jobs in which easy installation, long service life and full power delivery are particularly important. Full details available from manufacturer.

Manheim Mfg & Belting Co, Manheim, Pa.

Compactor Power Float

340 • Improved compactor power float is a portable machine for rapid and efficient compaction-floating of harsh concrete or asphalt mastic mixes recommended for superior, long-wearing, dust-free floors. Four cast-steel hammers provide rapid, heavy impact on the rotating disc. This action densifies and floats the slab to a smooth level surface. Further details available on request to manufacturer.

Kelley Machine Div, Wiesner-Rapp Co, Inc, 1600 Seneca St, Buffalo 10, N. Y.

For more data on these items, use post cards p 165. Identify your request with item number.

Plastic Coating

327 • New *Dip-Pak* formula #661 is a hot-melt, strippable coating that exhibits no oil exudation up to temperatures of 160 F. This material has cellulose acetate butyrate as its base plastic. Its transparency is extremely resistant to darkening under heat. A fairly tough, rubbery compound, *Dip-Pak* will remain flexible at temperatures ranging from –50 F to 160 F. It acts as semi-per-

4 GOOD REASONS
for specifying Watson-Stillman Forged Steel Fittings

Here's why **W-S FORGED STEEL FITTINGS** mean safe, dependable operation of your piping system:

1. They're *drop-forged* to produce the well-known forged fiber structure with exceptionally high tensile and impact strength.

2. They're "Safety-Factor" designed with heavy walls where you need them. Extra long bands extend well beyond the last thread.

3. They're precision machined. Special automatic angle indexing machines maintain precise angular accuracy for perfect alignment. Long accurate threads insure tight joints.

4. They're fully inspected. Gauges double-check the close tolerances, angularity, threads and sockets and concentricity.

WATSON-STILLMAN FORGED STEEL FITTINGS give you maximum resistance to pressure, temperature, corrosion, shock and vibration. They protect your system against costly shut-downs.

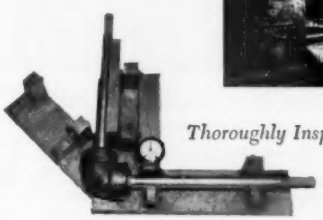
A complete line of forged fittings available in both SCREW-END and SOCKET-WELDING types in carbon, stainless and alloy steels. Write today for information.

Sold Through Leading Distributors

Drop Forged for Strength

"Safety-Factor" Design

Precision Machined



Thoroughly Inspected

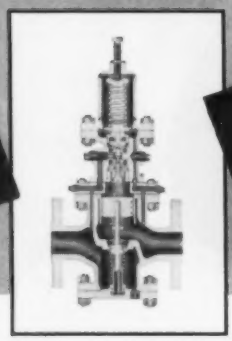
WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

For Regulation of Steam Pressures up to 1500 P.S.I.

The FOSTER 50-G2



Approaches Instrument Control

The Foster 50-G2 Pressure Reducing Regulator accurately holds reduced pressure at a steady level — from maximum capacity to tight shut-off — regardless of normal variations in initial pressure. Extremely sensitive throttling action means that there is never more than a small, momentary deviation from the set point. It is furnished arranged for self-contained operation or remote control, depending on pressure requirements.

Foster 50-G2 Valves need less maintenance because the materials used in their construction are resistant to erosion and corrosion of severe service conditions and they are further protected by internal strainers. When servicing is necessary, it can be done without breaking the line, and it is made easier by interchangeable parts and assemblies.

High inlet-to-outlet ratio often eliminates a secondary stage valve in supplying low pressure steam for such uses as deaerating water heaters, tank storage heaters and auxiliary exhaust systems.

Available for initial pressures 25-1500 P.S.I.; temperatures to 950° F.; reduced pressures from 15" Hg. to 600 P.S.I. Sizes ½" to 12". Write for Bulletin G-101.

75 YEARS OF EXPERIENCE

FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE — UNION, N. J.

AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

want to forget about rust for 20 years?

Pure zinc or aluminum, molten-sprayed on iron or steel surfaces, provides complete, dependable protection against atmospheric corrosion for upwards of 20 years without further maintenance. Such coatings are *mechanically* bonded to the surface—adhesion is *not* dependent on volatile vehicles or binders. Scaling, crazing, blisters, are eliminated. Protection is positive. "Metallize 'em and forget 'em!"

Why not find out more about how you can forget rust for 20 years or more? For descriptive Bulletin 62B—or the name of your nearest Metco Systems contractor—write or wire.

**Reg. U.S. Pat. Off.*

the Metco* Systems
—a series of 18 basic engineering specifications developed over 19 years of experience with pure zinc and aluminum coatings on many different types of structures and equipment. The *Metco Systems* provide for standardization of surface preparation, metal coating thicknesses and organic aftercoatings for various service conditions and appearance requirements.

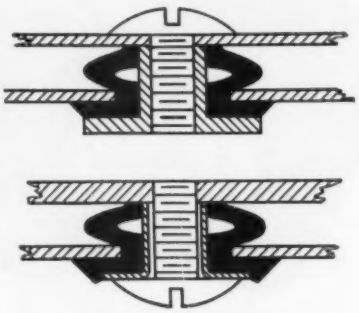
Metco Systems Dept. PO, 38-14 30th Street, Long Island City 1, New York

More EQUIPMENT NEWS

Begins on page 156

manent coating for metal, insulating compound and plating stop-off. Full details available from manufacturer.

Fidelity Chemical Products Corp, 470-474 Frelinghuysen Ave, Newark, New Jersey

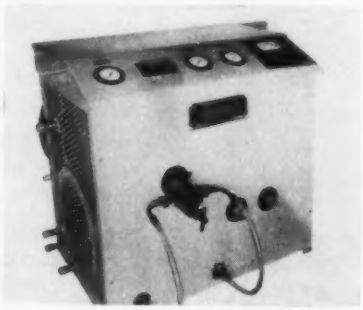


Vibration Isolator

331 • New T-nut isolators offer low cost, ease of installation and effective isolation of noise and high-frequency vibration. Units are applicable to small motors, transformers, panel-mounted instruments, etc. With a natural frequency of 35 to 40 cps, they provide excellent damping of vibrations above 100 cps. Resilient material is rubber, GRS or neoprene. T-nuts will fit through plates up to 3/16 in. thick in four available core lengths. Full details available from manufacturer.

Barry Corp, 700 Pleasant St, Watertown 72, Mass.

For more data on these items, use post cards p 165. Identify your request with item number.



Automatic Burner

356 • New Model PK-54 burner for intermediate size industrial plants is available in sizes ranging from 500 to 3000 lb oil per hr or the equivalent in gas fuel.

Unit is available in following arrangements: (1) automatic steam atomizing with semi-automatic mechanical cold start (2) automatic steam atomizing with semi-automatic mechanical cold start and automatic gas firing (3) automatic wide range mechanical atomizing with semi-automatic mechanical cold start (4) automatic wide range mechanical atomizing with semi-automatic mechanical start and automatic gas firing (5) automatic gas firing only.

Peabody Engrg Corp, 580 Fifth Ave, New York 36, N. Y.

(*Continued on page* 194)

If you've got your eye
on a profitable future,
plan now to give
positive protection
to expensive piping and equipment.
You'll avoid costly failure
due to expansion or contraction
by specifying Zallea
Duo-Equalizing Expansion Joints.
These joints are designed
to eliminate unequal distribution
of movement among the corrugations.
All corrugations move simultaneously
and equally during expansion or contraction
of the piping—and no corrugation
can be compressed or extended
more than the proportional amount
for which it is designed.

Zallea already has, or will make, expansion joints for every service. For information on standard types, request Bulletin 351. For consultation on special problems, ask us to have our representative call.

Zallea expansion joints

ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints

Leaf assembly being removed from one of three vertical filters at B. F. Nelson.

How B. F. Nelson Mfg. Co.

increased condensate in boiler feed 70%

with SORBO-CEL®

When B. F. Nelson Mfg. Co. added new 425-psi boilers, oil in condensate was an expensive problem . . . until they switched to Sorbo-Cel filtration.

Average oil concentration in old boilers was 65 ppm. Concentration in condensate receivers ran 33.4 ppm, mostly emulsified. About 50% of boiler feed was condensate. Problem: to keep oil out of new boilers. *By comparing methods, they found that filtration with Sorbo-Cel . . . a specially processed diatomite filter aid . . . did the best job.*

Sorbo-Cel slurry is fed into condensate to attract oil and hold it until it reaches filters. Sorbo-Cel collects on plates and builds up a highly porous cake. Operation is continuous until there is no more room for cake between plates—usually 70 hours.

Today, 85% of boiler feed is condensate. Labor-and-material costs are only 1.7 cents every 1000 lbs. Since B. F. Nelson produces two million pounds of steam a day, savings from reclaiming such a high percentage of condensate can readily be imagined.

For further information about Sorbo-Cel filtration mail the coupon below.

Johns-Manville

SORBO-CEL

Johns-Manville
Box 60, New York 16, N. Y. POW-3

Please send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

More EQUIPMENT NEWS

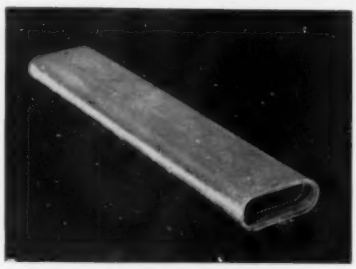
Begins on page 156

Indicating Lights

325 • New heavy-duty oiltight indicating lights feature all-glass faceted lenses factory-sealed to metal caps. Units have all-angle visibility and come in six colors: red, green, white, blue, amber and clear. Available in three forms—resistor, transformer, and full-voltage—they are rated from 110 to 600 v with 10-a continuous rating.

General Electric Co, Schenectady 5, New York

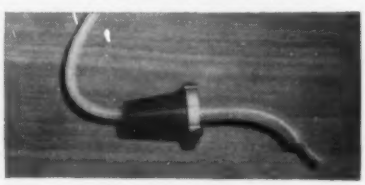
For more data on these items, use post cards p 165. Identify your request with item number.



Gas Vent Pipe

324 • New gas vent pipe, designed especially for "in-the-wall" venting has narrow oval cross-section that permits easy installation without extensive special construction or extra insulation. Air space separates inner and outer pipes. New *Fastloc* coupler permits joining without cement or mastic and without screws except where vent will be left exposed. Outer pipe is of galvanized steel. Aluminum inner pipe provides fast-heating "hot-stack" with maximum corrosion resistance. Full details available on request.

Metalbestos Division, William Wallace Co, Belmont, California



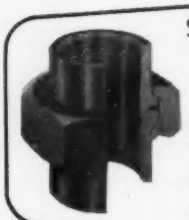
Pouring Spout

306 • New pouring spout for small containers provides safety, avoids fumes, odors

Catawissa PERFECT SEAL Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!



Standard & Double Extra Heavy UNIONS

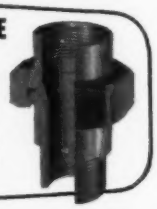
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS

With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

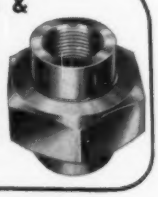
MALE & FEMALE UNIONS

With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.



FULL STAINLESS & FULL ALLOY STEEL UNIONS

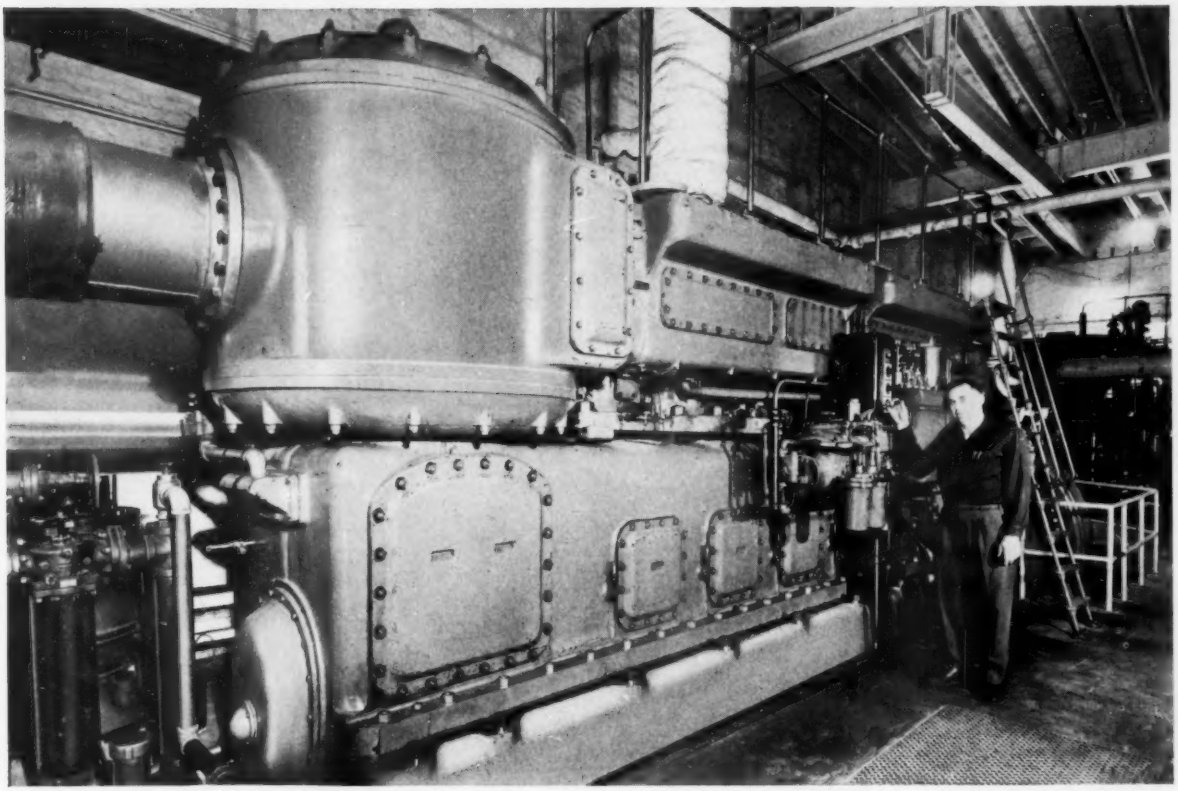
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



WRITE FOR CATALOG 11
showing the complete Catawissa line of Perfect Seal products

CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

"Our tests show Gascon® Oils best!"



. . . says A.E. Harms, CHIEF ENGINEER

YUKON MILL AND GRAIN COMPANY, YUKON, OKLAHOMA

It's *doubly* important that the Yukon Mill and Grain Company's 5 diesels operate with as little trouble as possible. For this plant not only supplies power for the mill, but also for the City of Yukon.

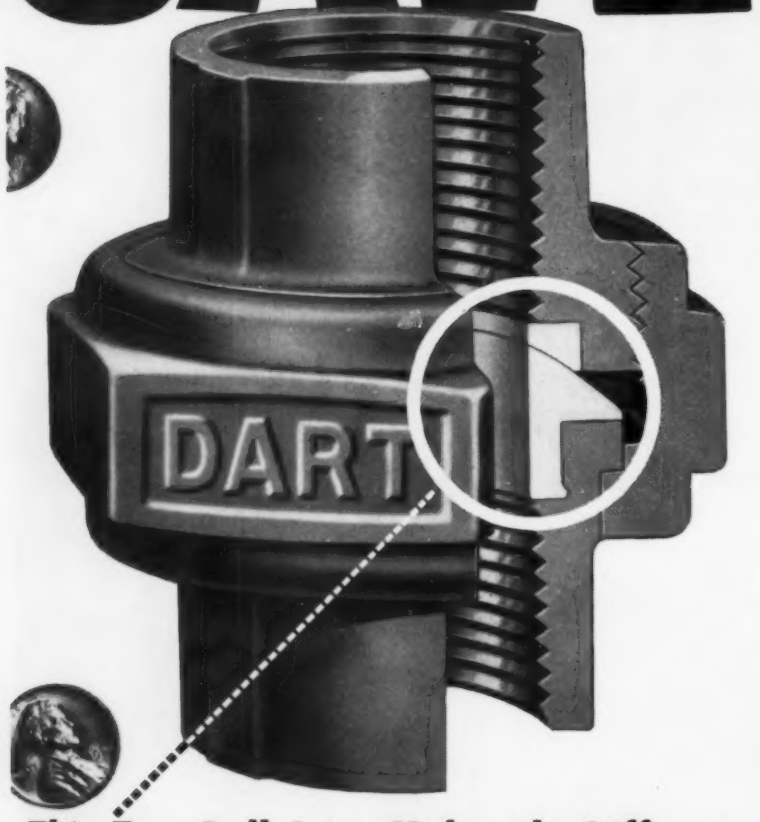
Chief Engineer Harms writes, "When we changed to Sinclair GASCON Oil D-HD, the results were extremely satisfying — wear has been greatly reduced, varnish is gone from pistons and cylinders and stuck rings are a thing of the past. As you might expect, we now use Sinclair exclusively."

You too, can rely on Sinclair's full line of top quality diesel lubricants. Phone your local Sinclair representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacements

Dart Unions SAVE



This True Ball Joint Makes the Difference

Darts save money because they can be used over and over again. One reasonable cost — many lives!

QUICK FACTS

- Leakproof because precision-machined to a true ball joint and spherically ground
- Bronze alloy seats are extra wide, resist pitting and corrosion
- Shoulders are heavy — take severe wrenching easily
- Practically indestructible Nut and Body... of air-refined, high-test malleable iron

Ask your supplier for Darts

DART UNIONS

DART UNION COMPANY • PROVIDENCE 5, RHODE ISLAND

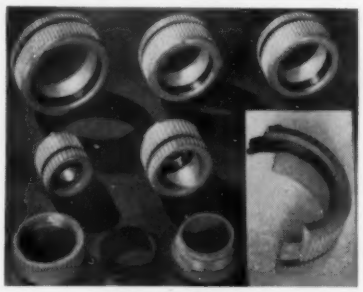
The Fairbanks Co. — Distributors: Boston • New York • Pittsburgh • Rome, Ga.

More EQUIPMENT NEWS

Begins on page 156

and prevents waste and spilling of liquids. Unit fits bottle openings from 1 to 1⅝ in. and has flow capacity of 1 gpm. Acid-resistant rubber and plastic tubing assure long life.

General Scientific Equipment Co, 2700 W Huntingdon St, Phila. 32, Pa.



Plastic Clamp

341 • Unique molded plastic clamp effects tight permanent seal when used in conjunction with insert couplings in plastic pipe. Units slide over pipe and force it down into serrations of inserts for positively leak-proof connections. Clamps are impervious to rot, rust and electrolytic corrosion. They are available for ½, 1, 1½, 2, 3, 4 and 6-in. plastic pipe. Units are tightened by means of a strap wrench.

Carlon Products Corp, 10225 Meech Ave, Cleveland 5, Ohio

For more data on these items, use post cards p 165. Identify your request with item number.

Safety Spectacles

338 • New shatterproof, multi-purpose safety spectacles offer almost 100% protection from eye injuries yet weigh little more than one ounce. Built-in visor, shaped to fit snugly against forehead, provides over-eyes protection against glare and flying particles. Lens flanges extending toward cheek prevent injuries from side or bottom. Lenses are optically correct to prevent eyestrain and are available in clear and three shades of green.

Watchemoket Optical Co, Inc, 232 W Exchange St, Providence, R. I.

(*Continued on page* 198)

INSULATED METAL WALLS

for POWER and STEAM GENERATING PLANTS

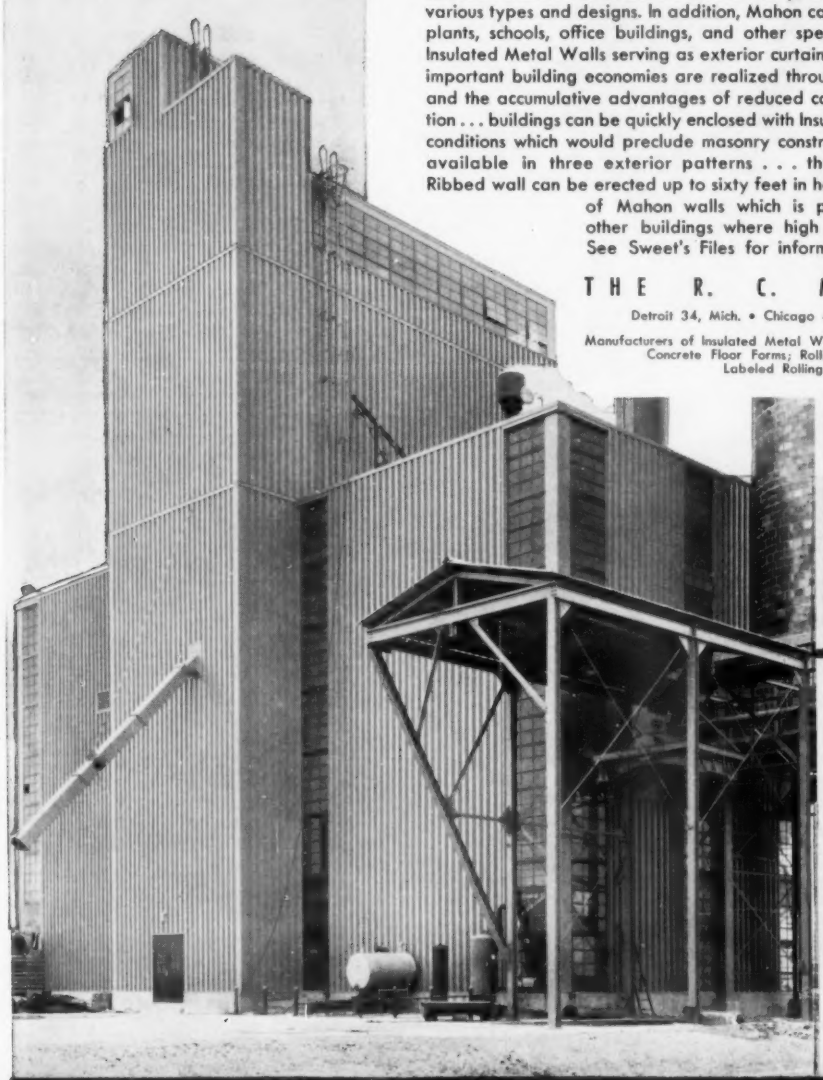
ALUMINUM, STAINLESS or GALVANIZED STEEL

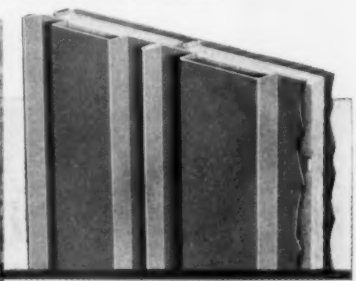
In the past five years, many power and steam generating plants have been built with Mahon Insulated Metal Walls. A number of these have Stainless Steel exteriors, others have Aluminum, and in others, Enamel Coated Galvanized Steel was selected for exterior surfaces. Included in these are Public Utility, Industrial, and Institutional powerhouses of various types and designs. In addition, Mahon can point to hundreds of complete industrial plants, schools, office buildings, and other special purpose structures built with Mahon Insulated Metal Walls serving as exterior curtain walls. In this type of modern construction, important building economies are realized through lower material cost, lower labor cost, and the accumulative advantages of reduced construction time resulting from rapid erection . . . buildings can be quickly enclosed with Insulated Metal Walls under low temperature conditions which would preclude masonry construction. Mahon Insulated Metal Walls are available in three exterior patterns . . . the Mahon "Field Constructed" Fluted or Ribbed wall can be erected up to sixty feet in height without a horizontal joint—a feature of Mahon walls which is particularly desirable in powerhouses or other buildings where high expanses of wall surface are common. See Sweet's Files for information, or write for Catalog No. B-54-B.

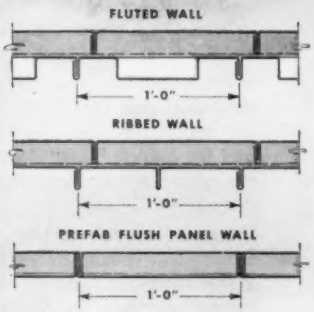
THE R. C. MAHON COMPANY

Detroit 34, Mich. • Chicago 4, Ill. • Representatives in All Principal Cities

Manufacturers of Insulated Metal Walls; Steel Deck for Roofs, Partitions and Permanent Concrete Floor Forms; Rolling Steel Doors, Grilles and Underwriters' Labeled Rolling Steel Doors and Fire Shutters.







The Over-all "U" Factor of the various Types of Mahon Insulated Metal Walls is Equivalent to or Better than a Conventional sixteen inch Masonry Wall.

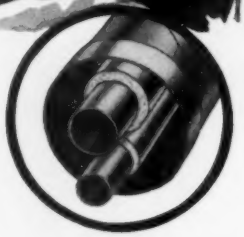
MAHON

Where a Job Well Done JOINS HANDS...

The veteran RIC-WIL field supervisor and contractor join hands in a JOB WELL DONE. Expert field service is available on all RIC-WIL installations.

There is satisfaction in achievement . . . the knowledge that *BOTH* the supplier and the buyer have given their best . . . and the best in Prefabricated Insulated Piping for underground and overhead systems is RIC-WIL.

The next time you specify . . . specify Quality . . . specify RIC-WIL. Write direct for Catalog No. 5401 or contact your local RIC-WIL representative.



RIC-WIL Multiple Systems

Send for Catalog No. 5401

Quality Piping Systems of the . . .
. . . Highest Mechanical Strength

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY
BARBERTON, OHIO

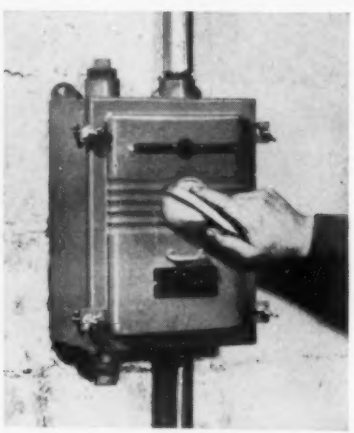
More EQUIPMENT NEWS

Begins on page 156

Safety Pilot

328 • New pilot, 700 series *Saf-T-Flame*, protects any gas-fired appliance against damage from failure of gas pilot or gas or electric supply. Unit is applicable to ovens, air heaters, immersion heaters, furnaces, metal pots, and similar industrial gas-burning equipment. Device uses flame conductivity principle to achieve instantaneous cutoff after pilot flame failure, requires no vacuum tubes. Each model consists of control cabinet, transformer and pilot burner with air mixer. All are available for 110 v, 60 cycle ac only. Complete literature available.
Partlow Corp, New Hartford, N. Y.

For more data on these items, use post cards p 165. Identify your request with item number.

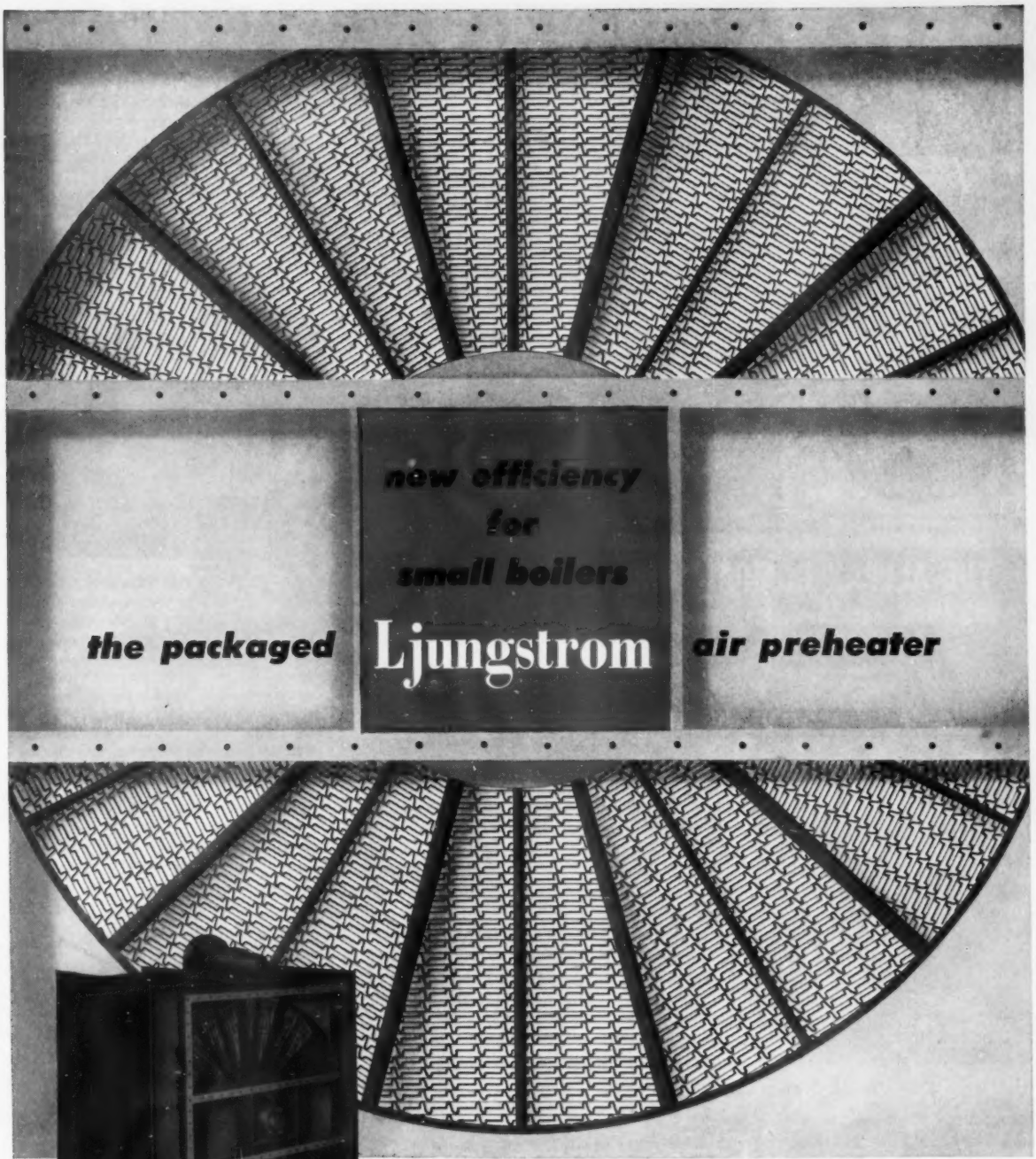


Switch Enclosures

312 • New lead-plated sheet-steel enclosures for safety switches and circuit breakers cover outdoor applications and other special conditions where cast-iron enclosures were formerly used. Units are lighter than cast-iron types and are especially suitable to humid, dust-laden or corrosive atmospheres.
Trumbull Components Dept, General Electric Co, Plainville, Conn.

High Velocity Motor

357 • New high-velocity fan-cooled motor, because of its greater cooling capacity, reaches much higher hp ratings with low cost and small frame sizes. New design permits mounting of 30-hp unit in No. 326



Even boilers as small as 25,000 pounds of steam per hour — can now operate at fuel efficiencies you never dreamed of. With the new *Packaged Ljungstrom*, you can apply the principles of heat recovery universally used in large utilities. The Packaged Ljungstrom Air Preheater operates on the *continuous regenerative counterflow* principle. Waste heat in products of combustion is absorbed on specially designed surfaces in the slowly rotating rotor. As the surfaces enter the stream of incoming combustion air, they transfer their heat to this air. The entire unit is self-contained as you receive it.

For more detailed information — get in touch today with The Air Preheater Corporation.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

ALLPAX

...the Packing that PACKS ALL

THEY ARE BEST by TEST

If it's high pressure + heat, use Allpax Style HP-2M. Excels against HP steam. It's best by test.

If it's chemicals + solvents + price, use Allpax *Teflon Packings.*

Allpax Packings assure complete satisfaction when used as recommended. Your packing problems are eliminated by the packings found *"best by test."*

ALL TYPES AVAILABLE

In coil, ring or loose form for temperatures to 6000° specials for higher temperatures.

ALSO

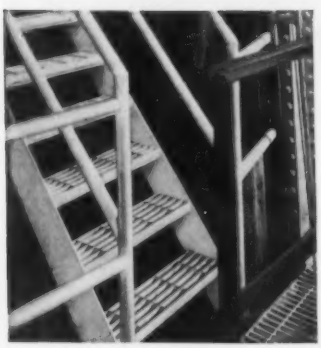
Valve Discs, Sheet Packing, Retainer Packing, Molded and Mandrel Cut Packing Rings, Packing Hooks; Gasket Cutters.

Contact your nearest distributor . . . or us direct

THE ALLPAX COMPANY INC.

805 Mamaroneck Ave., Mamaroneck, N.Y.

Superheat Sheet Packing . . . Oil Proof Sheet Packing . . . Red Rubber Sheet Packing . . . Diaphragm Sheet Packing . . . Cloth Inserted Sheet Packing



Safer ups and downs!

Here's a sure way to keep accident claims down and at the same time, give employee morale a boost. Install Hendrick Shur-Site Treads for stairs and fire escapes. Hendrick treads not only improve safety records but their 90% open area lets more light and air in—improves working conditions.

Bars are square edged and uniformly spaced for extra wear and long life. A heavy flanged nosing-bar provides extra reinforcement and plainly marks the edge of each step for safety's sake. Furnished in standard sizes or in special widths and lengths they're shipped ready to bolt direct to stair stringers. For more information write Hendrick direct.

Hendrick

MANUFACTURING COMPANY

46 DUNDAFF ST., CARBONDALE, PA. • *Sales Offices In Principal Cities*

Perforated Metal • Perforated Metal Screens • Wedge-Slot Screens • Architectural Grilles • Mitco Open Steel Flooring • Shur-Site Treads • Armorgrids

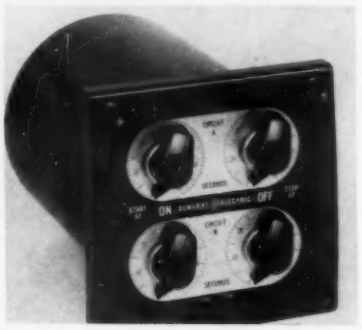
More EQUIPMENT NEWS

Begins on page 156

frame rather than the usual 365. Motors are available in ratings from 15 through 30 hp. All units feature drip-proof construction and can be furnished with either standard single-end shaft or special hydraulic pump mount endbells.

Reuland Electric Co, Alhambra, Calif.

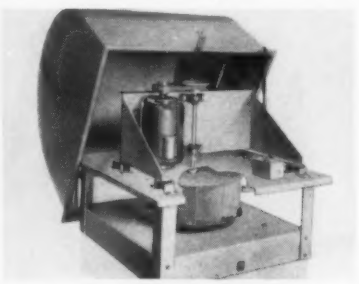
For more data on these items, use post cards p 165. Identify your request with item number.



Process Timers

343 • New line of process timers provides accurate, adjustable time-delay opening and closing of electric contacts. Designated *G-E Type TSA-18*, timers can control wide variety of process equipment. Improved features include extra-heavy nylon gears, overall construction of almost 100% pure zinc alloys, dust-resistant cover. Internally engraved connection diagram together with screw type terminals permit easy wiring. Unit measures 5¾x5¾x8 5/32 in., weighs 6¾ lb. Further details available on request to manufacturer.

General Electric Co, Schenectady 5, New York



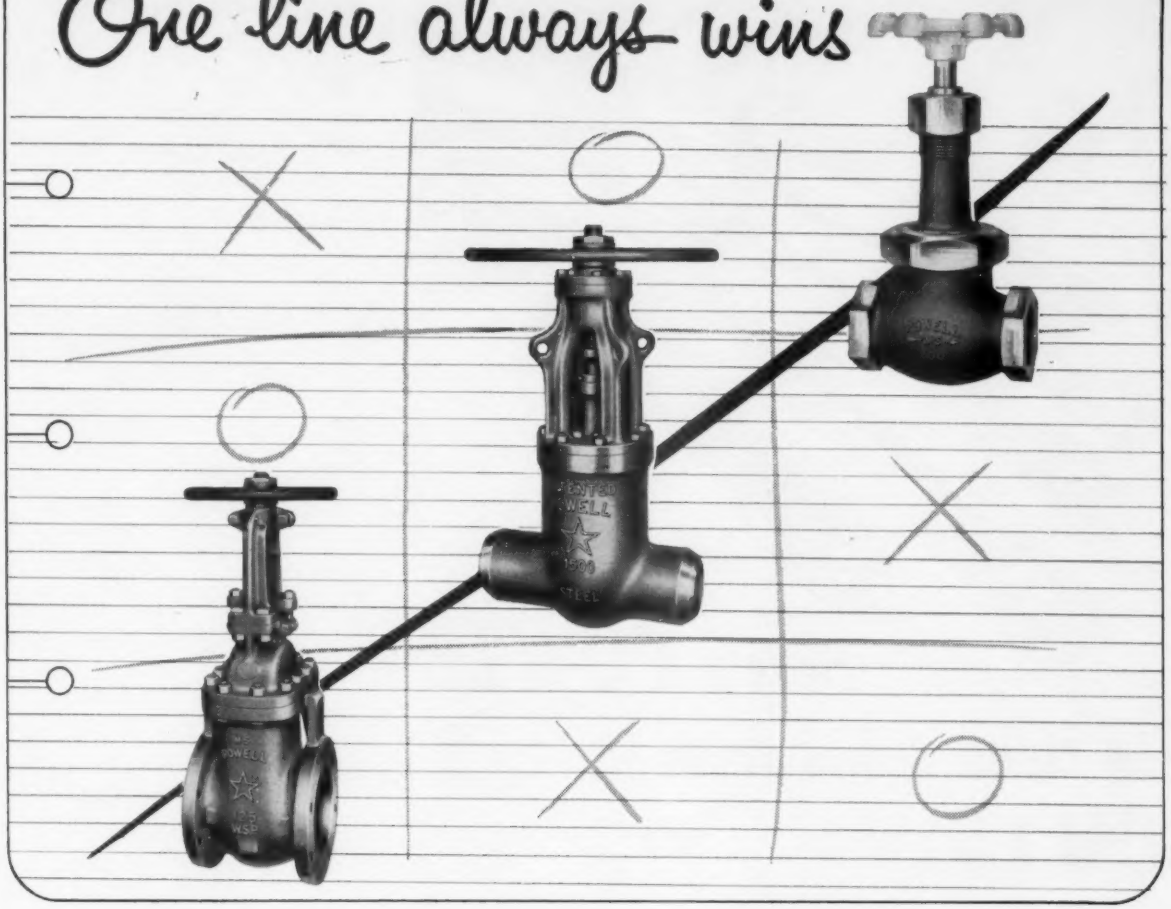
Fan Ventilator

323 • Mechanically improved and completely redesigned *Airlift* centrifugal fan ventilator features one section hood that covers motor chamber and directs exhaust downward for dispersion over roof. Hood lifts on swing hinges on smaller models, is removable on larger. This provides easy access to motor and fan chambers for servicing and cleaning. Designed primarily for low noise level duct exhaust, unit comes in 14 sizes and a wide range of available capacities at static pressures from 0 to ⅞ in. Full details available in manufacturer's bulletin AL-2.

Swartwout Co, Cleveland, Ohio

(*Continued on page* 202)

One line always wins



TOP

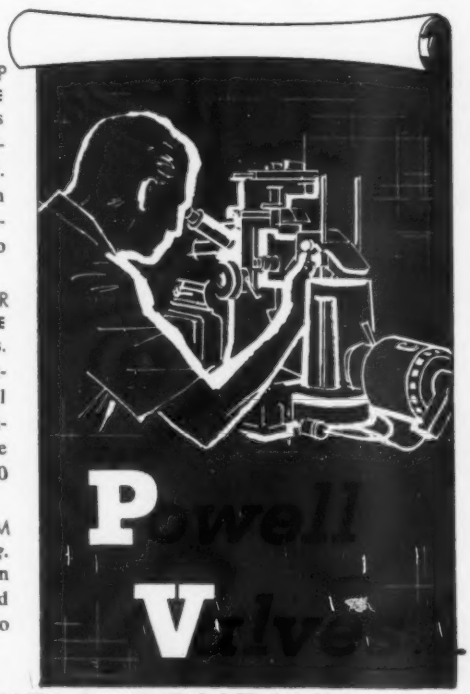
BRONZE "W.S." FULL FLOW GLOBE VALVE *(Fig. 2608)* for 200 pounds W.P. Regrindable, renewable, hardened stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow, with pressure drop and turbulence cut to minimum.

CENTER

PRESSURE SEAL CAST STEEL GATE VALVE *(Fig. 11303)*. 1500 pounds. Many proven advantages and exclusive features. Pressure Seal Valves are also available in Non-Return, Check, Globe and Angle Patterns for 600, 900, 1500, 2500 pounds.

BOTTOM

"MODEL STAR" GATE VALVE *(Fig. 1793)* for 125 pounds W.P. Iron body, bronze mounted. Supplied with taper solid wedge. Sizes 2" to 30", inclusive.



There's never any doubt about what tack to take in choosing the winning line of valves. It's Powell! For Powell Valves are manufactured up to The William Powell Company standards of quality—standards that have kept rising for more than a century.

What's more, Powell has a *complete line*—probably manufacturing more types of valves than any other organization in the world.

Powell Valves are available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you about our complete line and answer your questions. Answering questions is a specialty at Powell where solving valve problems has built the world's most valuable background of sound solutions.

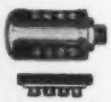
CONTROLS FOR THE LIFE LINES OF INDUSTRY

..... 108th YEAR

THE WM. POWELL COMPANY · CINCINNATI 22, OHIO

Here's POWER to clean tubes from 1/2" to 2" QUICKLY

Expanding scraper and replaceable element.



Expanding brush and replaceable element.

Sectional wire brush.

Air valve for one-man operation.

Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

Send for Bulletin J-410.

ROTOJET®

Junior TUBE CLEANERS

ELLIOTT COMPANY-ROTO DIVISION

153 SUSSEX AVE. • NEWARK 1, N. J.

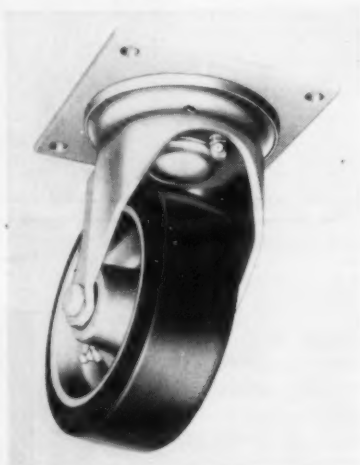
More EQUIPMENT NEWS

Begins on page 156

Pipe Threader

332 • New low-cost drive for hand pipe tools features weight of only 75 lb. Light but rugged, this machine is available with either gas or electric power and has a threading range of ⅛ to 2 in. Reversible, variable-speed ½-hp motor drives spindle at load speeds of 22 to 36 rpm. Illustrated fact booklet available on request to manufacturer.

Oster Mfg Co, 2057 E 61st Pl, Cleveland 3, Ohio



Sealed Casters

339 • New *3D Series* heavy duty casters feature design innovations that virtually eliminate need for lubrication. Main swivel bearing baffle ring prevents entrance of dirt and water, grease retainer prevents loss of swivel lubricant through vertical drainage, wheel bearing seal effectively excludes foreign matter and retains lubricant. Further details available in manufacturer's Catalog Sheet 3D99-53.

Bassick Co, Bridgeport 2, Conn.

Worthington Corp has associated itself with Niigata Engrg Ltd of Japan in setting up the new Niigata Worthington Co, Ltd. The agreement provides American capital, manufacturing rights and technology that Japan so urgently needs to revitalize her post-war industrial development. Horace E Wood, as Far Eastern Manager, will set up his headquarters in Tokyo.

Remember — the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered FOR ENDURANCE

THIS TUBE-TURN WELDING TEE is drawn from seamless tubing to a barrel shape—the form every tee wants to assume under pressure. This design, plus the generous crotch radius and thickness, assure exceptional strength and endurance. In tests of representative fittings, bursting pressures have averaged over 25% higher than required by applicable standards.

This extra quality at no extra cost is typical of all TUBE-TURN Welding Fittings and Flanges. For satisfying service, and to fill all your requirements from one reliable source, get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Los Angeles • San Francisco
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Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO • PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA.

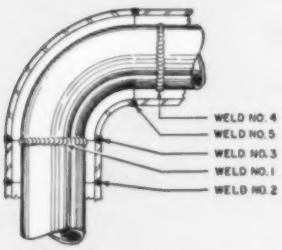
ENGINEERING SERVICE

TUBE TURNS' ENGINEERING SERVICE

develops new method of fabricating jacketed fittings

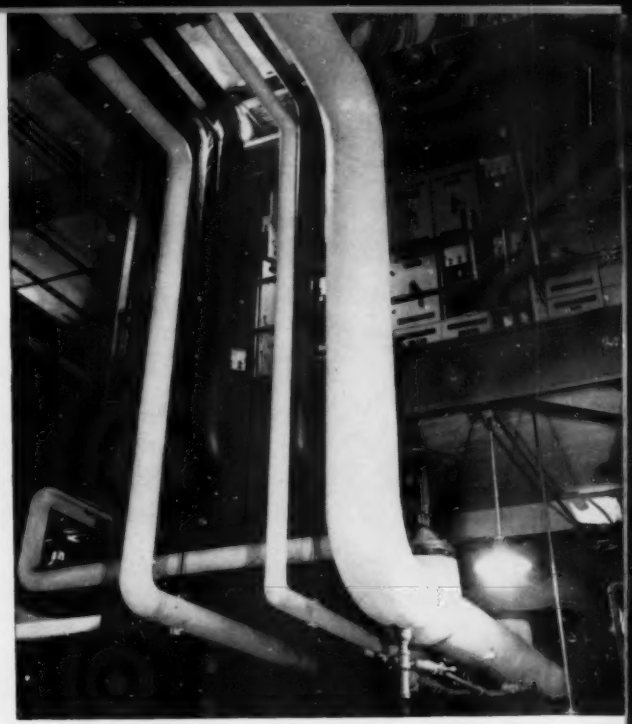
FABRICATION TIME AND COST can be reduced with this method of using welding fittings for directional changes in jacketed piping systems. The jacketed fitting combination consists of long and short radius TUBE-TURN Welding Elbows, with center-line radii closely matching. A tangent on one end of the inside elbow (see cut) extends beyond the corresponding end of the outside elbow. On the other end a short length of pipe is attached to simplify installation.

The method eliminates the need for steam and coolant jumpers, and also eliminates flanged joints, except where disassembly must be provided for. Insulation can be readily applied. Maintenance costs are sharply reduced, as all joints are permanently leakproof. The assembly provides optimum flow conditions, and minimized thermal problems.



Welding sequence for elbow of jacketed system.

This improved technique is another contribution to piping technology by TUBE TURNS' Engineering Service Division—always ready to help you with special piping problems.



These water, steam, and air lines, using TUBE-TURN Welding Fittings to make directional changes, provide permanently leakproof service. Note compactness of layout, and how neatly insulation is applied.

SERVICE is the middle name of your nearby TUBE TURNS' Distributor. He can help you fill all your requirements from one reliable source. TUBE TURNS, INC. offers the world's broadest line of welding fittings and flanges, in a wide range of types, sizes, and more than 40 different alloys.

Want Piping Information?

TUBE TURNS, INC. is recognized the world over for its leadership, not only in the field of welding fittings and flanges, but as a source of authentic information on piping design.

TUBE TURNS, INC., Dept. C-2
224 East Broadway, Louisville 1, Kentucky

Please send me free copy of Pipe and Fitting Materials.

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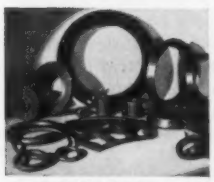
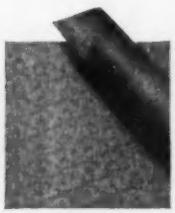
GARLOCK GASKETS

Made from these materials:

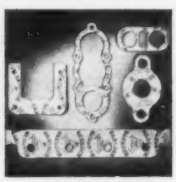
Asbestos, compressed	Natural rubber
Asbestos, metallic	Synthetic rubbers
Asbestos, woven	including:
Cork-fibre, glycerine	Buna-N (Hycar)
treated or	Butyl
synthetic-rubber	GR-S
impregnated	Neoprene
Leather	Silicone
Kel-F†	Thiokol
Teflon‡	Vegetable fibre



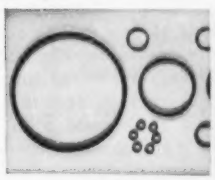
Molded Rubber Gasketing Devices



Compressed Asbestos Sheet



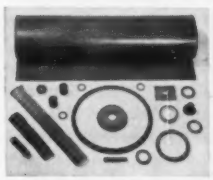
Duck Inserted Rubber Gaskets



"O" Ring Gaskets

Cork-Fibre Sheet

GUARDIAN* Asbestos-Metallic Gaskets



Silicone Gasketings

"Teflon" Envelope Type Gaskets with Compressible Fillers

Asbestos Tubular Gasketing

*Registered Trademark

There is always *one* type of gasketing material that's best for a particular application. When you call on Garlock, you're sure to get the material you need to meet your specific service requirements. Here's why: Garlock can furnish sheet packing or cut gaskets made from *any* one of the basic gasketing materials. We are *not* limited to a few gasketing specialties.

Therefore, whenever you need gaskets call in your Garlock representative. He can supply you with the type of gasket that will best meet your requirements.

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†The Kellogg Company's Trademark

‡Du Pont's Trademark for its Tetrafluoroethylene resin

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PK-54 BURNER

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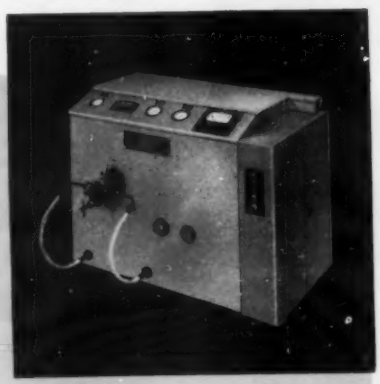

To fire oil or gas—or both—with unit capacity to 42,000 lbs. of steam per hour. Industry's most compact, complete, automatic burner, the PK-54 is designed for factory-assembled boilers or conversion installations. Available with steam or mechanical atomization and utilizing the Peabody Wide Range, Constant Differential System. High efficiency, low noise level, and complete accessibility are only a few features of this, the most modern burner in the industry. Literature available on request.

PEABODY ENGINEERING CORPORATION

580 FIFTH AVENUE, NEW YORK 36, N. Y.

TOPNOTCH OPERATION

Continued from page 97

Probably a middle course will combine the good features of both sides. And use of high speed, remote recording or scanning-type meters, equipped with limit alarms will aid in accurate recording and checking.

Retain plant records for a reasonable period of time. File and index plant design prints and manufacturers' instructions, and keep them in a convenient place for ready reference. Keep summary records of costs and payroll permanently, and hold important operating summaries for a considerable number of years. Preserve log sheets and charts, material records and the like for five to seven years for the sake of comparing unit performance details. Less important papers need be kept for only a year or two.

In general, retention period for records should coincide with general company policy and tax or regulatory body requirements.

Test Program. You will want to make periodic tests of equipment to insure safety of both men and machines, and to check reliability, capacity and efficiency of plant equipment.

Some tests, like trial of low-vacuum and overspeed trips, can be simulated each time a turbine is shut down. Make actual tests of overspeed trip operation every three or six months. Occasionally pull safety valves by hand or by remote control to see that they are free to operate, and pop them on overpressure every year or two. Check to see that they open and close approximately at design pressures.

Devices for cutting off fuel in case of improper combustion can ordinarily be tried out by simulating the adverse condition artificially. As a rule, test the interlocks, electrical relays and overtravel stops without actual switch operation, but make a complete, actual test every two or three years.

A regular preventive maintenance program for all equipment will catch many troubles before they cause a shutdown. More complete inspection at less frequent intervals, with partial or complete dismantling, will spot internal defects.

Inspect bearings, governors and other bearing parts, Magnaflux wheels and blades for cracks, and test insulation during periodic inspection of turbine-generators. Inspect and make hydrostatic tests of boiler pressure parts at least once a year. Test boiler at one and one-half times normal working pressure to assure that it remains in good condition after long years of service. Test rivets for caustic embrittlement failure.

Cut out test samples of high-pressure high-temperature welds and analyze to determine whether there is graphitiza-

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Hundreds of plants already are saving real money by reducing their inventory from dozens of different oils and greases to *a few Pure Oil multi-purpose lubricants*—lubricants scientifically formulated to do many different jobs equally well.

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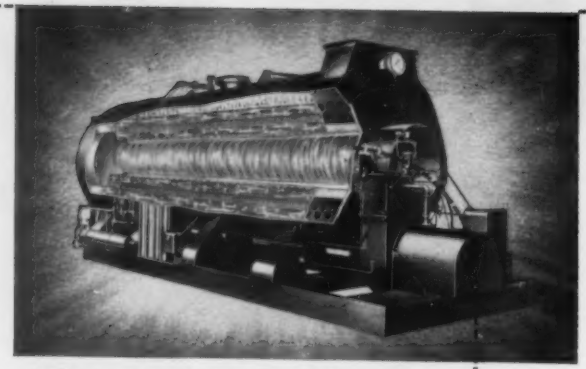

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• The Cyclotherm Cyclonic Combustion Principle is an entirely new and amazingly different method of heat transfer in the boiler industry.

• Air enters the combustion chamber at extremely high velocity in a revolving spiral vortex which travels the entire length of the furnace. The fuel is introduced into the entering air where it is slowly consumed as it moves in a cyclonic motion down the combustion chamber. This highly luminous slow burning flame radiating heat to the fire tube through direct radiation and by convection, results in an unusually high rate of heat transfer.

• *No matter what size the building or job, Cyclotherm has the correct installation. Send for your copy of "All Your Questions Are Answered by Cyclotherm" today and find out for yourself the facts concerning Cyclotherm Steam Generators.*

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TOPNOTCH OPERATION

Continued from page 206

tion of weld metal. Check pipes internally for corrosion or deposits that may cause inopportune leaks or plugging. Test meters and controls periodically, and recalibrate if necessary. Inspect insulating oil, and use Doble and megohmmeter testing for electrical insulation.

Inspect elevators and cranes periodically, usually in conjunction with insurance representatives.

To keep plant efficiency high, make periodic operating tests. Standard monthly load checks on turbines show whether capacity is falling off because of blade deposits. Giving turbine a complete test before and after a major overhaul will determine results of changes made.

Check condensers each month or two to find out whether heat transfer and circulating-water flow are up to standard. Occasionally check terminal difference in closed heaters and similar devices to insure against waste of heat.

Check pump head and efficiency under some standard set of operating conditions at 3- to 6-month intervals to reveal whether pumps are deteriorating and need overhauling or are still in condition to produce good results. Test boiler combustion and air infiltration frequently to help assure most efficient fuel burning and reveal leakage of additional air into the setting. Checking draft loss under standard load conditions will reveal increased resistance in boiler heat-transfer surfaces like superheaters, economizers or air preheaters.

More PLANT PROBLEMS

Begins on page 132

tain 40 F in the tank. Or a flow of 16,000 gph will maintain a temperature of 35 F. Direct heating with 45-psig steam requires about 2000 lb per hr of steam.

If the full tank is left uninsulated at –60 F and zero flow, it will take 3.3 hours to cool from 40 to 32 F.

Insulation of tank and piping, therefore, appears desirable. The only problem here is that in summer the water temperature will be much less than the dewpoint of the surrounding air. So *NN* must take precautions to seal the outer surface of the insulation against both rain and water vapor. If he neglects this, atmospheric moisture will accumulate in the insulation, destroying its effectiveness. Tank temperature is too low to drive off this moisture during dry periods. For best results, he should choose an insulation with high moisture and penetration resistance.

I recommend 2 in. of rock cork insulation for this tank. A weatherproof-

NEW

LUNKENHEIMER QUARTER-INCH BRONZE NEEDLE VALVES

Fig. 906

Solve your space problems!

INSTRUMENT BOARDS ARE CROWDED — and up until now, the size of needle valves installed behind instrument panels has been a serious problem. But this revolutionary new quarter-inch valve *saves as much as 20% in size* — yet is actually stronger than the conventional design.

It's safer, more accurate, and more compact — easier to install and maintain! The reason: the body of the new figure 906 is carefully machined out of a cast block of close-grained bronze. It gives you all three of the "most wanted" needle valve features — great strength, compact size, and absolute accuracy of flow control.

Figure 906 is available in a wide range of sizes and in both globe and angle patterns. The quarter-inch size, designed for instrumentation, is only 2¾ inches high — 1½ inches wide. Larger sizes, where bulk is not a problem, are comparable to conventional needle valves. In the globe design, you can take your choice of famous Stemalloy® bronze stems or cadmium-plated steel stems. All patterns have new gland followers and fine thread-pitch for close regulation.

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QUALITY

BRONZE • IRON • STEEL

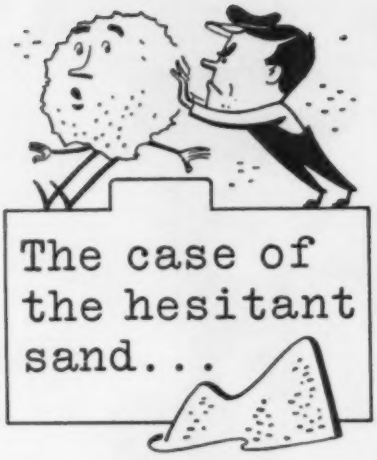
FOR MORE INFORMATION, request Circular 568. Your Lunkenheimer Distributor has it, or you can write for a copy to The Lunkenheimer Company, Box 360A, Cincinnati 14, Ohio.

*Patented Alloy

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-153-23



Yes, a New England foundry really did have a case like this. As the sand started down through the overhead bins and hoppers, it paused uncertainly, sort of reared back and held up production something terrible.

Fortunately, the foundry superintendent called us for advice. In short order a battery of CLEVELAND vibrators were installed on the bins, and the sand hasn't hesitated ever since.

Whatever your hesitant material . . . cement, steel chips, ore . . . just tell us — or ask for our detailed literature.

AIR *and* ELECTRIC

2824 Clinton Avenue • Cleveland 13, Ohio

More PLANT PROBLEMS

Begins on page 132

ing cover of asbestos and portland cement, with an outer coating of weatherproofing and vapor-sealing asphaltic material, is also needed.

Best application methods for the insulation and weatherproofing can be obtained from the manufacturer. In the past three years I've had some enlightening if painful experiences with water towers used for small communities in western Canada. From these I learned that adequate rain and vapor seals on the outer surface of the insulation are extremely important. Be sure to anchor weatherproofing directly to the tank instead of trying to support it on the insulating material.

I also recommend rock cork for pipe insulation. It is available with factory-applied vapor- and weather-proofing. It is interesting to note that with ice-water thickness on a 6-in. cold-water pipe, 3.95 hr are required to cool the water from 40 to 32 F, when there is no flow in the pipe. To prevent freezing, 3.8 lb per hr per linear ft should flow through the pipe. With brine-thickness covering, freezing time is 6.0 hr, flow 2.5 lb. When heavy-brine thickness is used, time is 7.0 hr, flow 2.17 lb.

Insulating the tank with rock cork sheets will reduce heat loss to 50,000 Btu per hr, requiring a flow of 625 gph to maintain 40 F in the tank. Time to cool from 40 to 32 F with no flow is 128 hr.

E H THRING, *Manager*
Industrial Insulations, Canadian Johns-Manville Co, Ltd, Toronto

OTHER READERS sent good answers to this question. Sorry we didn't have enough space for their letters. They are:

L G MATHYS *Montreal Canada*
HARRY CONGDON *Beloit, Wis.*
J W SMITHWICK *Washington, D.C.*
PAUL ZIEMKE *Oak Ridge, Tenn.*
HOWARD HOLCOMBE *Los Alamos, N. M.*
M N COLLISON *Flin Flan, Manitoba*

MARMADUKE

Continued from page 144

"Next morning I hired a horse and carriage at Mueller Bros Livery Stable just off Olive St and Broadway and drove across the Eads Bridge to my first prospect. The plant was about six miles away and the weather was plenty cold for early March.

"After getting there, I hitched the horse in front of the office building and covered him with a blanket. My plan was to visit the boiler room first and get some inside information before tackling

More inches of VISIBILITY . . . and No Blind Spots with *NEW Jerguson* STEAM GAGES

Assembly No. 618

You get more inches of visibility within centers available . . . and no blind spots with the New Jerguson Steam Gages with the horizontal expansion loop. The special new compact valve, with a *horizontal* loop that keeps the strain off the gage assembly under varying conditions of expansion and contraction, gives you maximum gage room within the centers.

The special offset single piece gage chamber design with staggered glasses and covers gives you continous visibility of the water level *with no blind spots* between gage sections.

The gage can be turned at any angle, yet there are no stuffing boxes between gage and valves. The ingenius design of the assembly includes a bracket so the gage will always stay in vertical position. The OS&Y valves have renewable seats and are standard with quick closing stem for chain operation, as shown, or available with plain closing stems and chain wheels.

Made in three designs of single piece chamber: for one, two, or three section glass for any W.S.P. Any Jerguson standard gage may be supplied with stems and flanges for use with this expansion loop valve.

Write for full information on Jerguson New Steam Gages with Horizontal Expansion Loop Valves.

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Where temperatures range from Minus 90°F. to 500°F. ANKLON is your answer!

ANKLON is made from du Pont's Teflon. Due to its chemical inertness and its ability to resist the destructive action of the mineral acids, organic solvents and alkalies, it is finding many uses in packing and gasket applications.

The illustration shows gaskets fabricated from sheet, machined packing rings and molded packing rings made from Teflon.

Anklon is widely used in the chemical, petroleum, refining, food, electrical, power and maritime industries.

For specfic uses, contact our Engineering Department.

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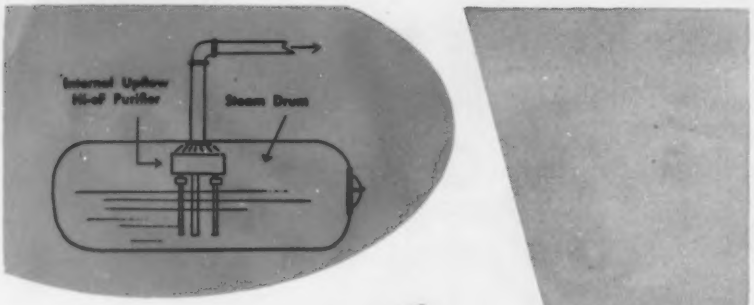
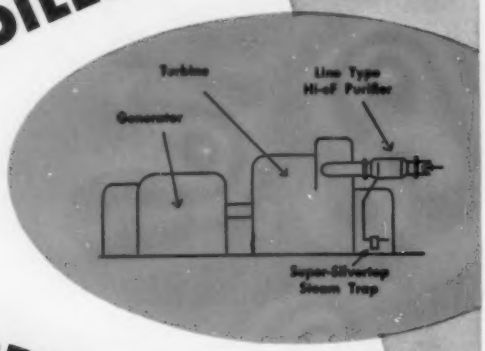


FROM BOILERS



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Everywhere in power generation and distribution systems, Anderson has the answers to entrainment problems that accompany the utilization of steam, air and gases. Hi-eF Purifiers provide a new, economical way of producing clean, dry steam from boilers. They also prevent slugs, dirt and moisture from damaging costly turbines and engines. And by keeping air clean they keep pneumatic control and replacement costs down to a minimum. Hi-eF Purifiers utilize a new scientifically-improved design principle combining multi-stage baffle and centrifugal separation. Perfected by America's leading separator engineers, they are filterless, without moving parts and as a result maintenance-free.

Whatever your entrainment problem may be, rely upon experienced Anderson engineers for the proper solution. Mail coupon for brochures.

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1934 West 96th Street • Cleveland 2, Ohio

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Name_____ Title_____

Company_____

Address_____

City_____ State_____

MARMADUKE

Continued from page 210

the president. The steam engineer was busy looking after a coal delivery, but I saw he had three hrt boilers at 125 psi.

"Walking over to the large machine shop I found the horizontal steam engine that drove the long line-shafts on both sides of the shop through a 12-inch leather belt. This shop made me feel at home because I had served my machinist apprentice time in a place like this. So I walked about, finally heading for the squeeling belts that ran the three large planers at the far end.

"When I got there, one of the planer hands was pouring ground coffee into a coffee pot from a paper sack. The pot was already full of cold water.

" 'That coffee pot looks mighty good to me,' I said, patting my midships section. 'I just drove over from St Louis and I sure could stand some Btu's inside.'

" 'Stick around, stranger,' he answered. 'I'll take this to the blacksmith shop and get her boiling. Grab yourself a cup there and I'll be back in a few minutes.' That gave me an idea.

" 'I'll save you the trip,' I told him, and with that I took the coffee pot from his hands. He watched me suspiciously as I walked over and set the pot on the 2-in. steam line running along the wall.

" 'This'll boil before you could get to the blacksmith shop, wait for it to boil and then get back here,' I told him. Then I asked if Phillipe ever came into the machine shop.

" 'Sure does,' said my machinist friend. 'He comes past here every morning at 9:15 sharp, come hell or high water.' This was good news to me.

"The two of us chewed the fat as we watched the large planer scrape a big hydraulic-press casting smooth on one side. In about ten minutes the pot was boiling and the coffee aroma spread to us. My friend reached for two cups.

" 'I'll do the pouring when the president comes past here in a few more minutes,' I said, glancing at my gold watch. And by golly, just as the machinist had said, there came a distinguished-looking man down the aisle. He was evidently making his daily inspection tour, for he seemed to take in everything.

"When he got to the steaming coffee pot next to the planer, he stopped dead in his tracks. I walked calmly over with the two cups. He sniffed the coffee and looked at me questioningly.

" 'I'm Marmaduke Surfaceblow of the Whitlock Insulation Co,' I began. But before I could finish, he came back sarcastically with, 'I thought you were selling coffee.'

" 'Not exactly,' I answered, 'but you

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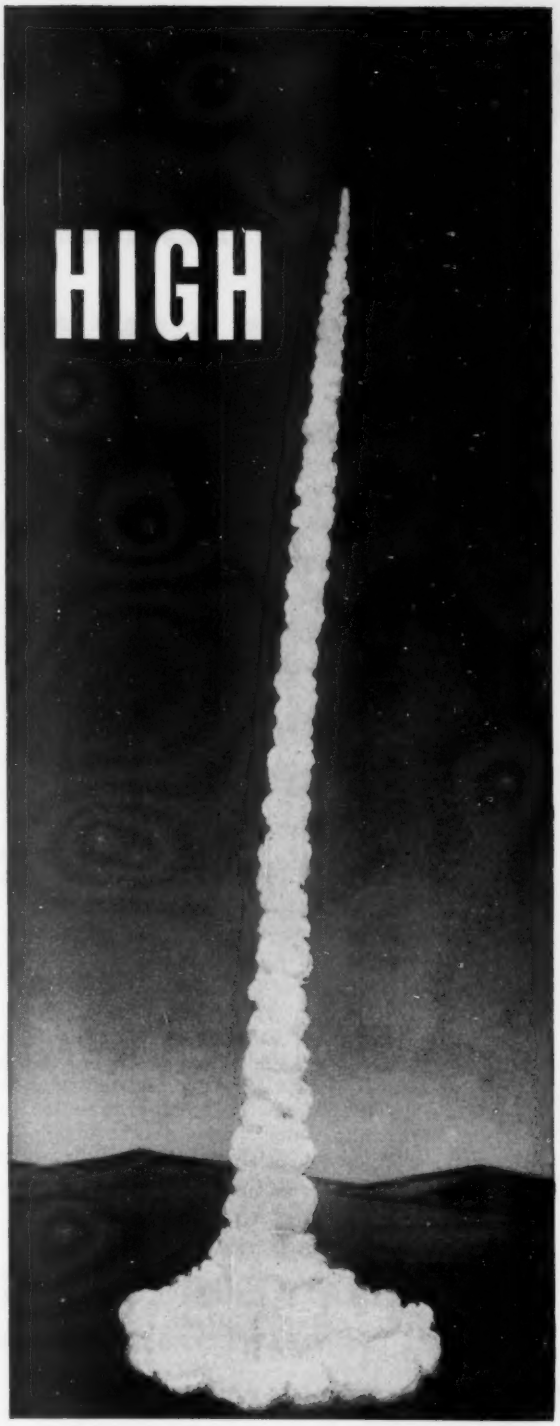

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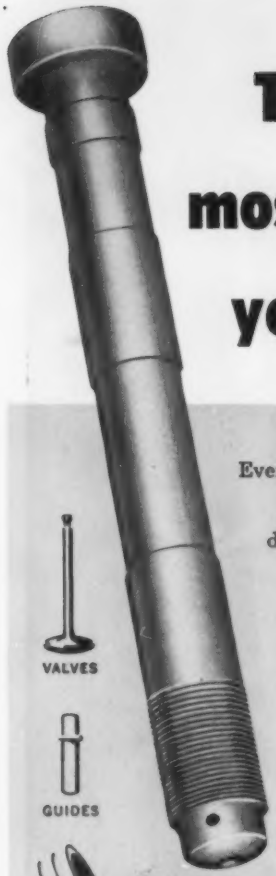

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MARMADUKE

Continued from page 212

might say this hot coffee is selling insulation.'

" 'You're making riddles,' said Phillipe, getting annoyed.

" 'Well,' said I, 'I notice you have about 500 feet of overhead piping running outside from your boiler room to the various buildings. With 15-psi steam in these low pressure lines, this coffee is boiling inside the building here. But you also have several 125-psi 4-inch lines outside. With the temperature down to 22 degrees today, you're using a few tons of coal just to heat the outside atmosphere. Fact is, you could have hundreds of coffee pots boiling on those lines right now.

" 'I'll admit that heat radiating from these bare lines inside the plant here does heat the building,' I continued, 'but you run your steam engines and steam pumps in various buildings the year round, six days a week, ten hours a day. So covering your bare lines will enable you to fire only two of those three boilers in winter. Savings from that one operation will not only pay for insulation, but you'll save that amount every year, for years to come.

" 'Here,' I said, 'have a cup of coffee and let's talk it over.'

" 'I don't have to talk it over,' he said to my surprise. 'I'm sold. All that fancy figuring Mr Whitlock sprung on me left me cold. I guess it's because salesmen usually juggle figures around to prove a point. And I don't claim to be an engineer. But your boiling coffee here really opens my eyes.'

"Up in his office we talked prices while he had two mechanics busy tracing out lines and jotting down dimensions and other data. That afternoon I drove back to St Louis with an insulation order to cover 4000 feet of piping.

"Here," barked Marmy, grabbing the fountain pen out of my hand unexpectedly and autographing his book.

"Every person is a little different, so you have to tack when sailing before the wind. A pot of boiling coffee in this case made more sense to Phillipe than all the cold mathematics that Whitlock threw at him." —*SME*

New Westinghouse ac generator, with only permanent magnets for field supply, occupy less space than an eight-in. cube yet deliver one kw. The two-pole permanent magnet, made of an *Alnico* alloy having high magnetic energy per unit volume and high tensile strength, operates at high speed to generate its relatively high output. Generators of this type work well as small emergency power units in situations where a separate source of direct current for the field would be inconvenient.

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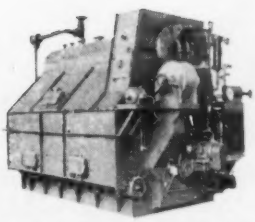

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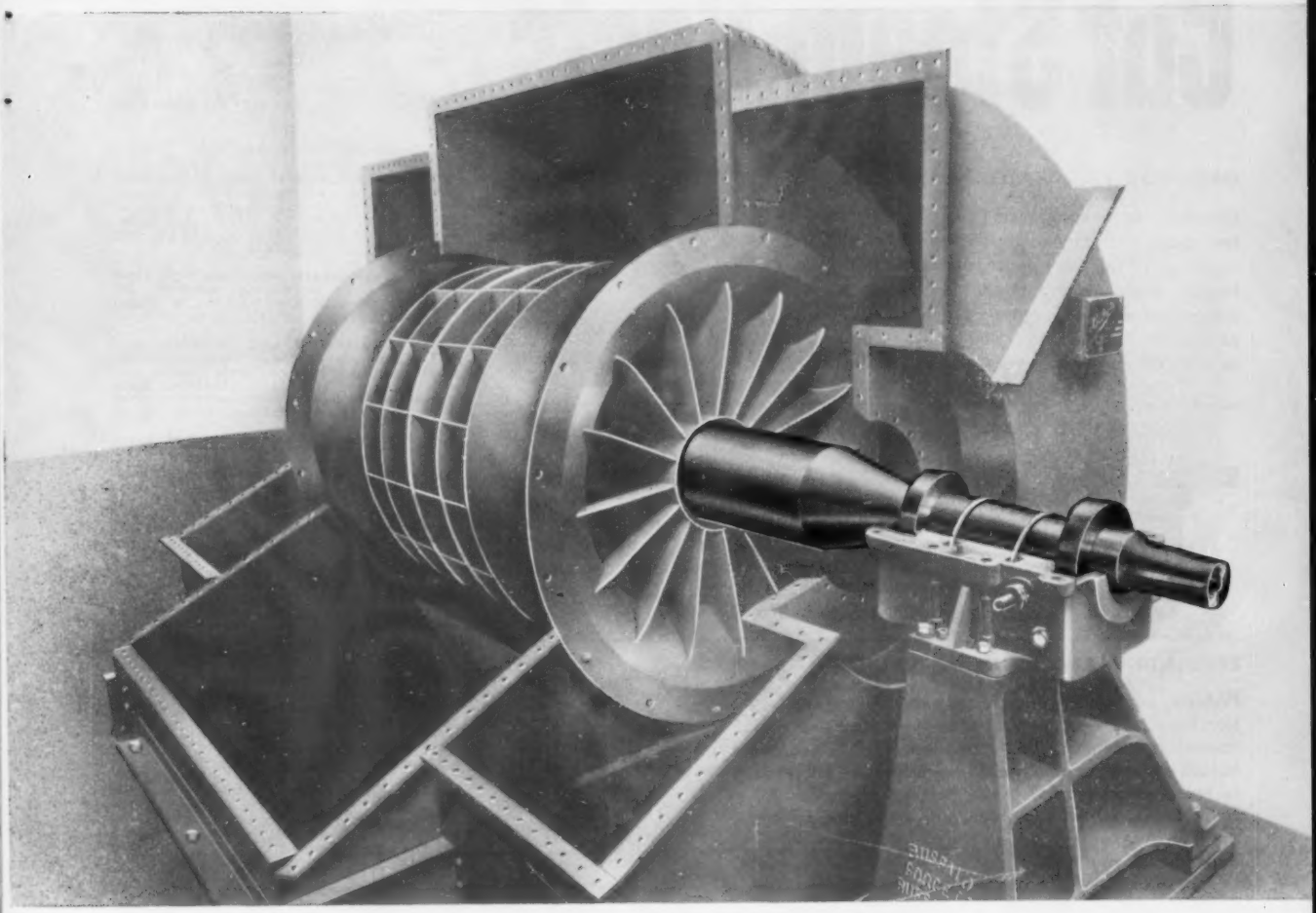

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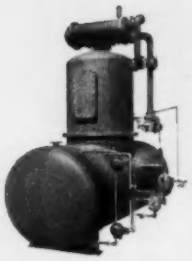

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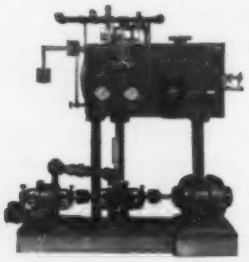

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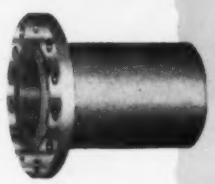

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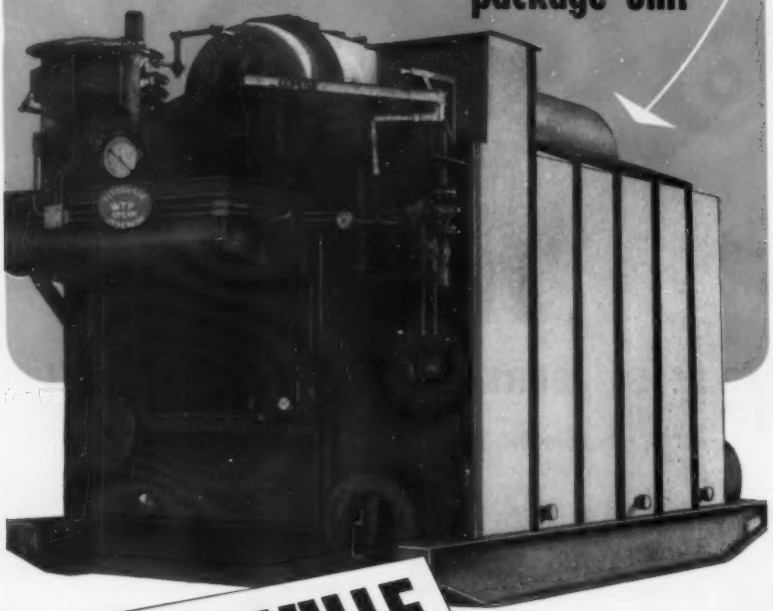

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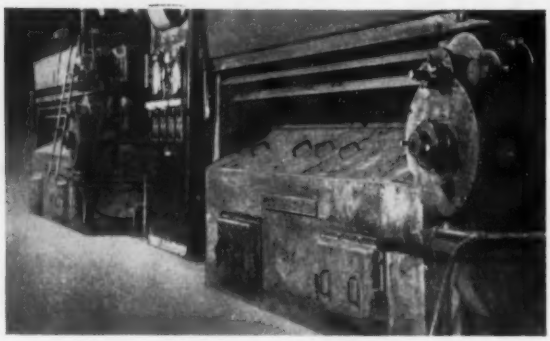

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More TECHNICAL BRIEFS

Begins on page 152

load scheduling by Power Supervisors and Steam Plant Betterment Department and "Equipment Overhaul Committee" for most economical maintenance and outage plan.

The paper also includes a table of the highest number of maintenance man-hours needed by specific equipment in three plants on the author's system. *ASME Panel discussion—no number.*

Directions for ordering papers on p 154

A Short Method for the Evaluation of the Effect of Some Thermal-Cycle Variations on Steam-Turbine Heat Rates. *By S D Fulton, Steam Turbine Engineer, Westinghouse Electric Corp.*

This method gives necessary accuracy even when making calculations with a slide rule. Calculations involve only the differences and not a complete set of heater calculations. This is done by considering secondary effects of a cycle change as a complete cycle with a given heat input. Change in shaft work and heat input can be calculated easily with this method.

Equations are developed to calculate effect on turbine heat rate of: (1) change in distribution of feedwater enthalpy rise between two adjacent heaters (2) change in pressure drop of extracted steam (3) change in heater-terminal difference (4) change in drain-cooler approach (5) effect of compressibility on feedwater enthalpy (6) inclusion or omission of evaporator condenser (7) changes in feedwater enthalpy from an external heat source (8) change in final feedwater enthalpy (9) inclusion or omission of an evaporator (10) change from flashed or drain-cooler heater to a contact or pumped heater or vice versa.

Method uses usual heat-balance data and procedure. It consists of substituting values from a heat balance in simple equations. Inspection of these equations usually shows effect of changes in different parts of a heat cycle. Appendix of paper derives the more extensive equations and works out a complete example for all equations to show how they are applied. *ASME Paper No. 53-A-97.*

Atomic Energy

Status of Nuclear Power Reactor Technology. *By J W Landis, The Babcock & Wilcox Co.*

The author reviews status of ten types of reactors considered for nuclear power plants. From the brief review he concludes that most promising ones for "forseeable future" are pressurized light-water thermal converter and pres-

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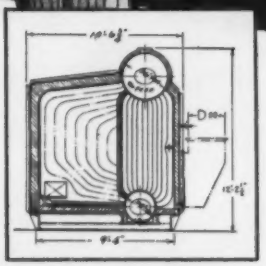

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More TECHNICAL BRIEFS

Begins on page 152

surized heavy-water thermal converter, with sodium-cooled graphite converter a possible alternate for the latter. Most promising "long range" power reactors are sodium-cooled fast cast-plutonium breeder and heavy-water homogenous breeder.

Problems reactor designer must solve include: (1) Achieve greater burnout of both natural and enriched fuels to reduce frequency of chemical processing. (2) Reduce complexity and cost of chemical processing. (3) Reduce or eliminate expensive fuel-element fabrication. (4) Compare fuel costs of breeders with those of converters. (5) Eliminate external heat exchange by boiling in reactor core. (6) Attain high specific power. (7) Reduce corrosion by coolants and liquid fuels. (8) Apply superpressure water technology.

(9) Design inexpensive leak-proof equipment to handle liquid metal coolants. (10) Improve methods of internal and external breeding. (11) Work out better controls, especially for fast reactors. (12) Develop construction materials that do not absorb neutrons parasitically, and that can withstand high temperatures and intense and prolonged neutron bombardment. (13) Discover new useful coolants. (14) Reduce costs of special materials such as zirconium, beryllium, heavy water, titanium, etc. (15) Simplify construction generally. (16) Develop methods for handling and disposing of radioactive wastes to minimize health hazards. (17) Fabricate better shields at lower costs.

The author then reviews history and present status of industrial participation program. There are over 60 companies actively engaged or interested in development of industrial nucleonics. There are three nuclear reactors in operation to produce electric power. The first was experimental breeder reactor powering a 200-kw plant at National Reactor Testing Station in Idaho. Second is Homogenous Reactor Experiment at Oak Ridge National Laboratory driving a 150-kw turbine. Third is Mark I Submarine Thermal Reactor, also in Idaho. *ASME Paper No. 53-A-227.*

Directions for ordering papers on p 154

Progress Toward Industrial Atomic Power—The Problem From An Economic Standpoint. *By C C Whelchel, Pacific Gas and Electric Co.*

Until large scale nuclear power plants are constructed and operated, present field of economics will continue to be one of speculation that can be approached from many angles. In single-purpose nuclear power plant, plutonium

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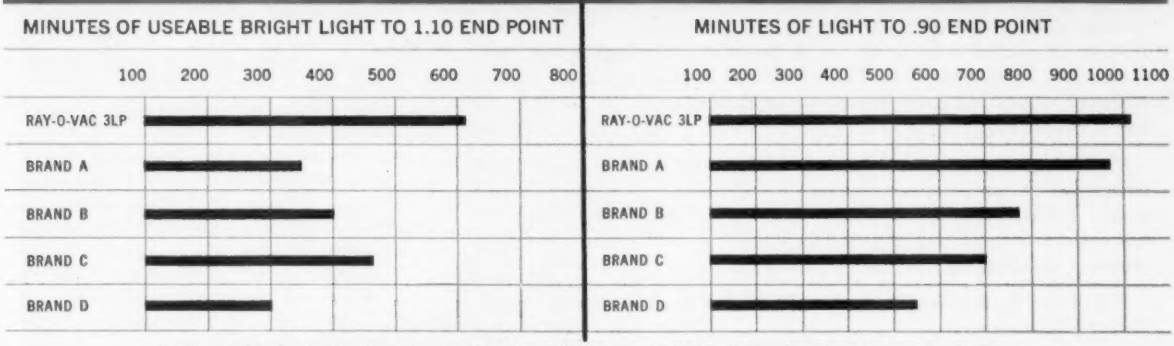

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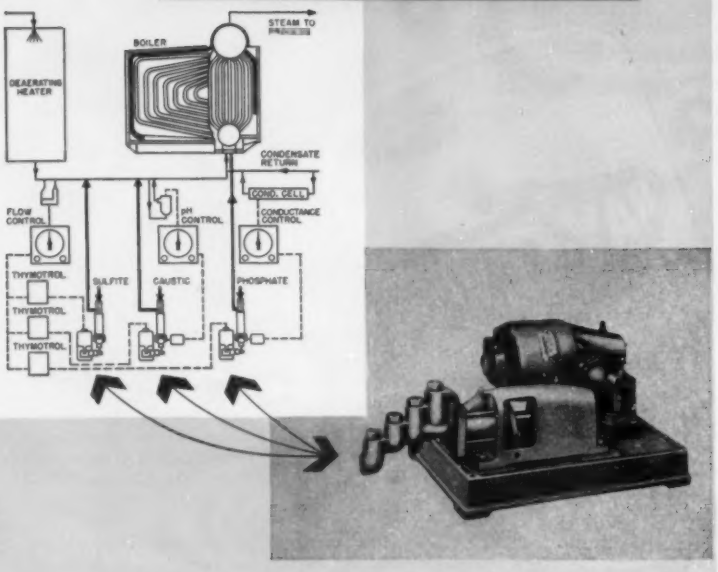

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More TECHNICAL BRIEFS

Begins on page 152

byproduct is of material value in supplementing fuel supply of U-235. As plutonium is made in reactor, some of it is consumed in reactor and is of immediate value. Because of radiation damage to fuel element or decreased reactivity resulting from accumulation of fission products, fuel element is removed from reactor when only part of fissionable material is consumed.

On removal, fuel element contains fuels U-235 and plutonium, fertile U-238 and fission products. For early reactors it may be economic to store this potentially valuable material until cost of chemical separation is lower than cost of purchasing new fissionable and fertile material.

If ratio of plutonium made to U-235 consumed were one or greater, reactor would be a breeder and, with recycling or sale of fuel, cost of raw fuel material would be negligible. Fuel cost, however, must include all costs associated with fuel and these include fuel element fabrication, chemical separation and waste disposal. These costs are now high. Value of the plutonium byproduct to nuclear power plant is in reducing fuel cost when fuel is recycled through reactor or sold for use in other reactors.

Today's estimates of capital costs for nuclear power plants vary greatly, range from $350 to $900 per kw for large plants. To be competitive, they must be lowered to something like $200 to $300 per kw. This disparity is a challenge to ingenuity in design of reactor systems.

Present estimates for cost of power produced by nuclear fuel are in range of 10 to 20 mills per kwhr. Such costs assume long and reliable operation. These compare with 6 to 7 mills per kwhr costs of conventional modern steam plants.

We do not expect nuclear power to supplant power generated by hydro and steam stations. When and as nuclear power becomes economical, we believe it will fit into nation's growing power systems without displacing or preventing future construction of steam and hydro plants. *ASME Paper No. 53-A-228.*

Directions for ordering papers on p 154

Nuclear Power—The Legal Situation. *By E B Stason, Dean of the Law School, University of Michigan.*

The author reviews unique legal problems that must be solved for private power generation by nuclear energy. He discusses these under the heads: I. A. The foundation of ownership of facilities is lacking. B. The foundation of

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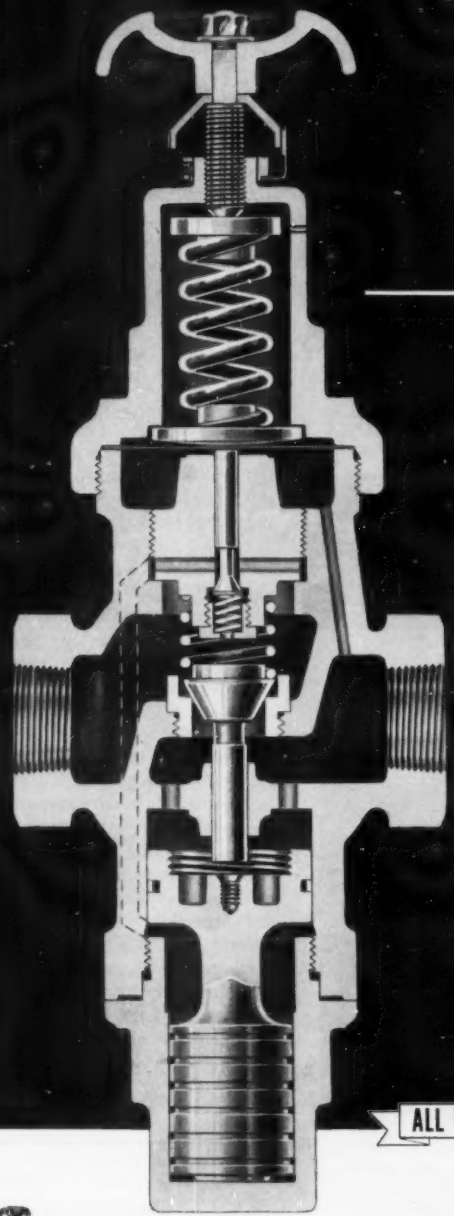

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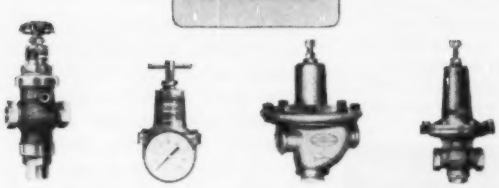

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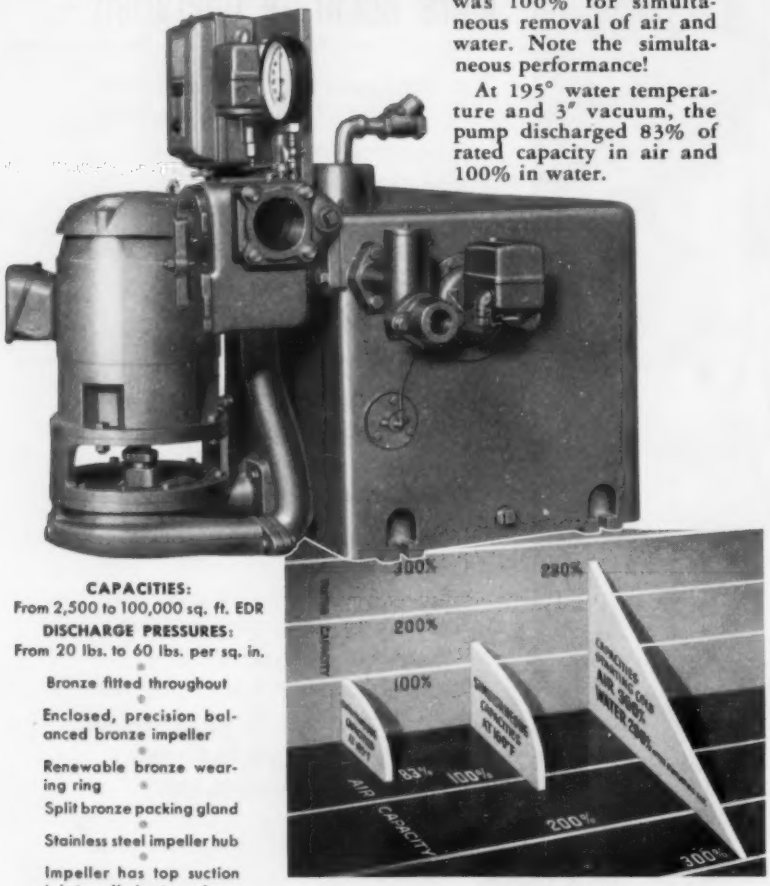

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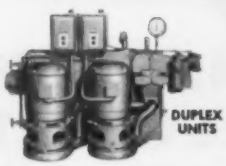
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More TECHNICAL BRIEFS

Begins on page 152

ownership of fissionable fuels is also lacking. C. The foundation of accessibility of source materials is also lacking. D. The foundation of right to continuity in business is also lacking.

II. The patent problem. III. Certain other federal legal problems. A. Stream pollution. B. Antitrust laws. C. Public utility holding company act problems. IV. Problems arising from state laws. A. The certificate of convenience and necessity. B. Approval of security issues. C. Acquisition of stock. D. Approval of intercompany contracts. E. Rate regulation. F. Safety regulations. G. State conservation. V. Local laws and legal problems.

All of the legal problems mentioned must be solved, although co-operation of Congress and state legislatures may be required to solve some of them. *ASME Paper No. 53-A-230.*

Creative Engineering

Design of Power-Plant Tests to Ensure Reliability of Results. *By W A Wilson, Assoc Prof of Mechanical Engrg, Massachusetts Institute of Technology.*

Tests must be designed to assure reliable results. Testing plans should include: (1) determination of required performance relationships (2) Control of testing costs by (a) proper placement and operation of instruments (b) making runs in best order with proper data-gathering procedure (c) good division of labor among testing crew (d) on-the-spot analysis to expose anomalous results (3) Data reach their greatest usefulness by (a) anticipating operating ranges of most interest (b) analyzing and interpreting results.

Uncertainty analysis should be made to determine degree of reliability of a test procedure. This can be made in orderly fashion as follows: (1) Define performance parameters in mechanical and thermodynamic terms. (2) Work backwards from these semi-abstract parameters to observable physical quantities. (3) Consider alternative methods of making determinations. Major alternatives may be an inferential

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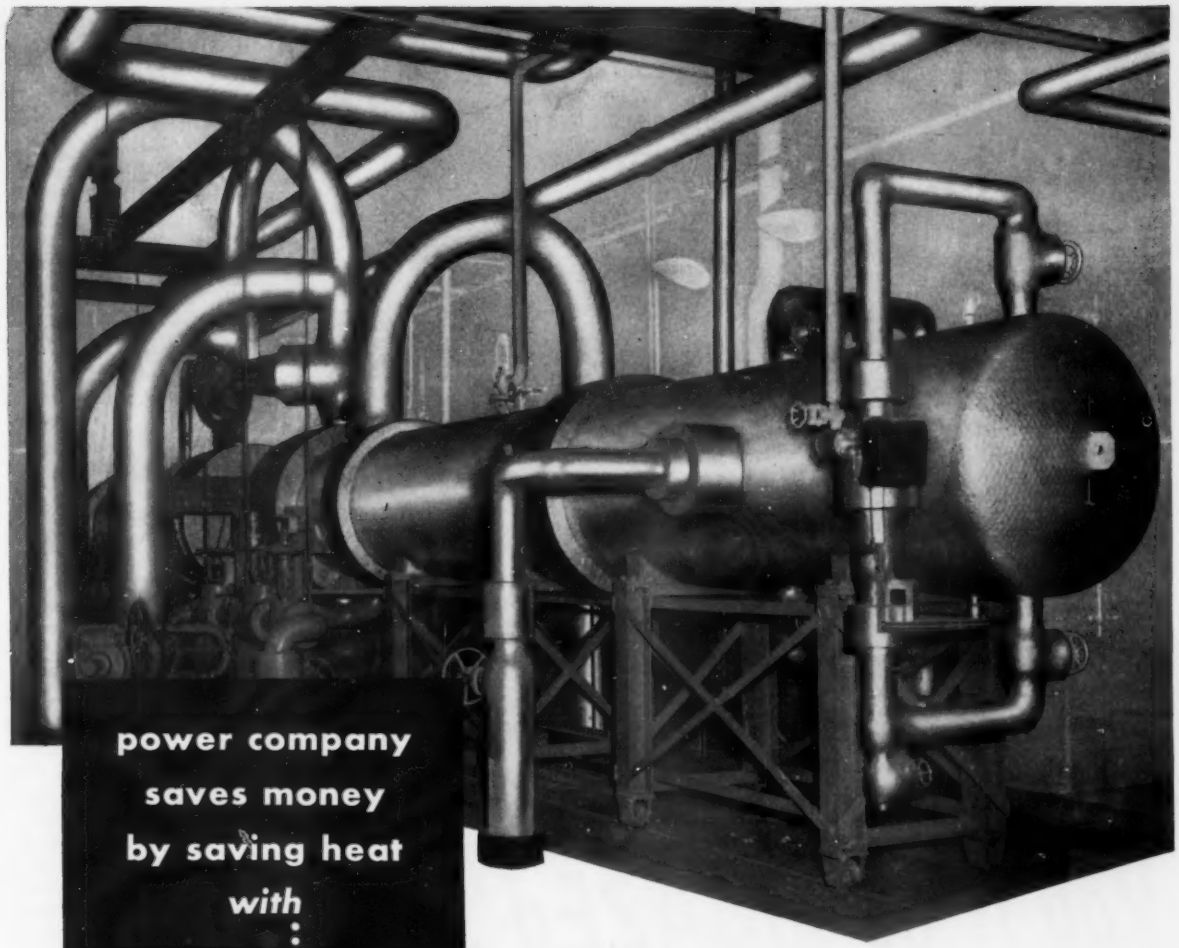
method against a direct-measuring process. Minor alternatives would be a choice between types of instruments. A third order alternative would be choice of specific instruments. (4) Make preliminary uncertainty estimates. This paper discusses this at some length and shows an example of how it should be done. (5) Make detailed analysis of final design. (6) Complete the test de-



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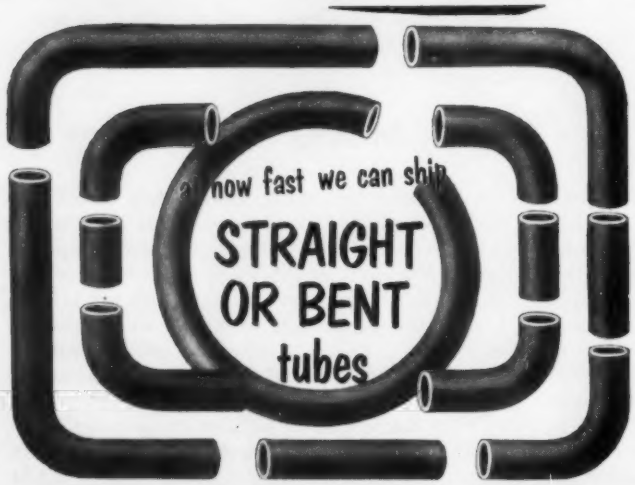

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More TECHNICAL BRIEFS

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sign by balancing uncertainties. (7) Take a final look at complete test procedure.

The author cautions that a background of experience in testing is important to distinguish important from trivial decisions in designing a procedure. *ASME Paper No. 53-A-156.*

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Instruction in Creative Mechanical Design. *By G B Du Bois, Mechanical Engineering Department, Cornell University.*

Practice on ingenuity problems reduces fear of unfamiliar situations and considerable initial gain in this respect appears possible. Mechanism of ingenuity can be likened to memory process. Problem is to approach a mental gap close enough by practical work so that the mind can see across. Ingenuity problems divide into two classes: (1) those needing an improved solution can use a transition method (2) those lacking a solution can use several initial suggestions.

For an elective course in mechanical design based on fundamentals and productiblity, the ingenuity element adds interest, increases design experience, allows three or more solutions to be required and has an inspirational value leading to a more advanced mental attitude. Most problems do not require genius—just a little actual work with a pencil.

The author concludes that practice increases an individual's natural ingenuity. Practice encourages confidence and combats mental block resulting from fear of an unfamiliar situation. Actual problem of finding a design solution is often less difficult than finding one that is feasible economically, or one conforming to space and weight limitations. *ASME Paper No. 53-A-172.*

Deliberate Creativeness in Engineering. *By M Nelles, Borg-Warner Central Research Laboratory.*

Creativeness in engineering results in optimum design and maximum usefulness. An engineer's ability to be creative can be developed and with proper understanding of principles involved. Engineers can deliberately create new things and processes. Creativeness in engineering is one of the important keys to technical and sociological progress. Because of its importance, engineering work should be checked for creativeness as well as adherence to fact.

In determining goals for engineering work, following topics are discussed: *Studies of Data on Needs; What Are the Deficiencies of Present Entities; Are*

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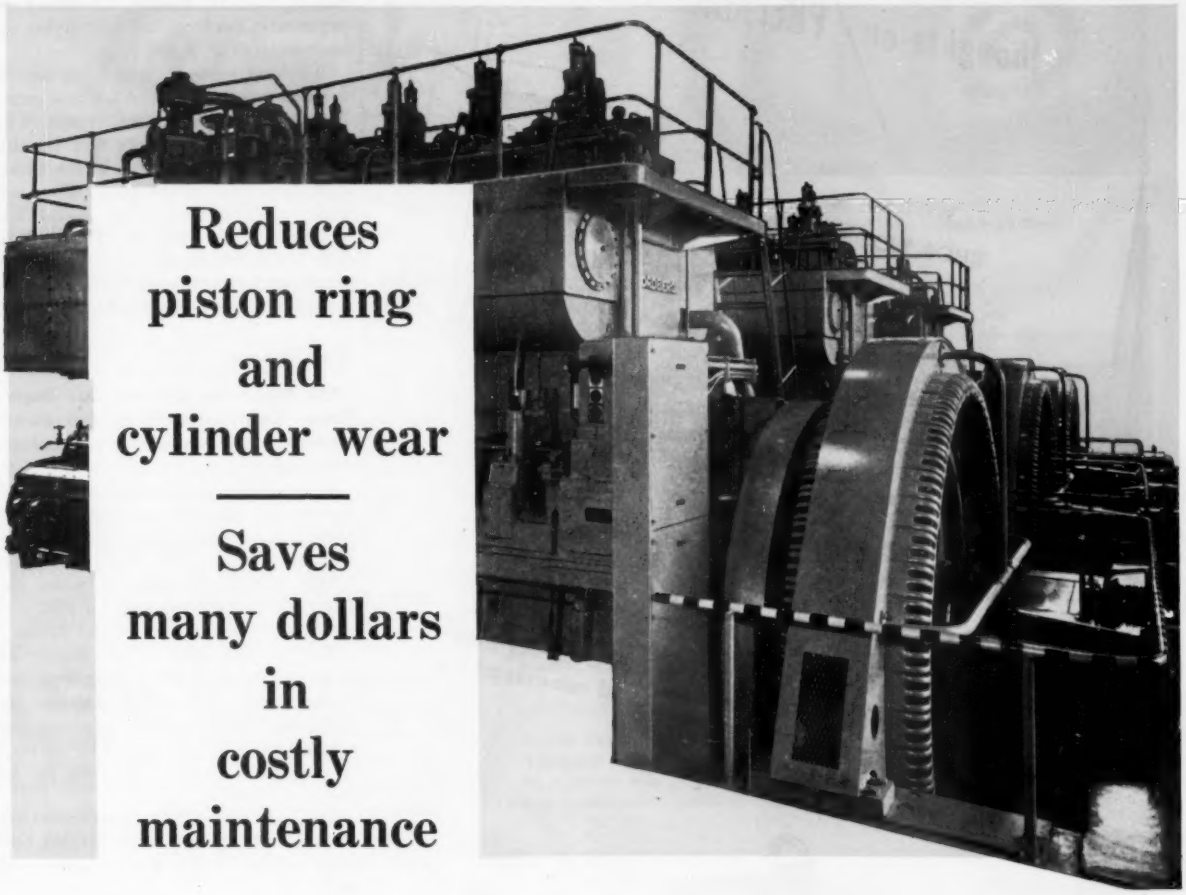

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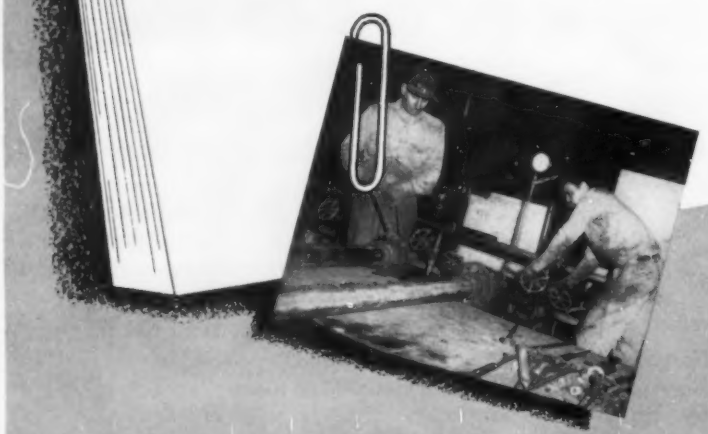

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More TECHNICAL BRIEFS

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Substitutes Better; Intimate and Imitate and Improve.

In achieving goals, the author explores: making preliminary designs; making models; making laboratory experiments; reading; talking; trying opposites; trying limits.

We have passed through an age of random creativeness and are now entering one of deliberate creativeness. With this technique, engineers will be able to accomplish much more in the future than they have in the past. They will make their devices more useful and available to more people. They will be able to understand real needs of people, groups and governments and fulfill them. *ASME Paper No. 53-A-171.*

Miscellaneous

1953 Report on Oil and Gas Engine Power Costs. *By Oil & Gas Power Division, American Society of Mechanical Engineers.*

Compilation of 25 successive annual reports on oil and gas engine power costs is not a minor achievement. Completion of such a task is exactly what ASME announced recently when the latest report, based on data for 1952 and preceding years, came off the press.

For the first time in the history of these reports, data cover more than one billion kwhr. Other vital statistics include data for 137 plants containing 557 engines rated 654,734 bhp. This exceeds in number of engines and total hp all previous reports.

The body of the 1953 report comprises 37 pages of tabulated data divided into three tables. Table I, the plant cost table, shows:

1. plant ownership (utility, municipal, industrial)
2. plant type (base load, peak load, standby)
3. number of engines and total rated hp
4. total plant hours operated in reported period
5. total output in (a) gross and (b) net kwhr
6. load factors (annual plant, running plant capacity, plant service)
7. average cost of fuel and lubricating oil in cents per gallon
8. costs per net kwhr in mills for: fuel, lubrication, attendance, supplies and miscellaneous, engine repairs, all other plant repairs and total production costs.

Table II lists costs by years for plants reporting for successive years. Although

Directions for ordering papers on p 154

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CONTROL

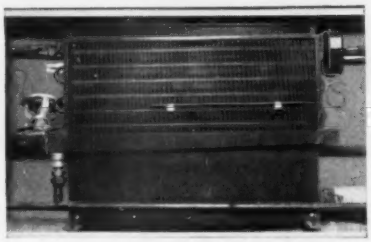
Gateway Center, crown jewel of Pittsburgh's fabulous Golden Triangle, is acclaimed everywhere as a triumph of advanced design, engineering skill and farsighted enterprise. In its creation, perfection was the only standard.

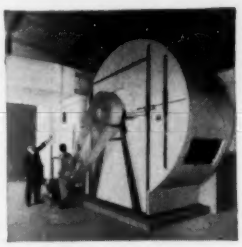
For example, with Johnson Control in command of the air conditioning system, there is automatic comfort control every minute of the day for the 8,000 people who will occupy these modern buildings. In each bay or private office on the periphery, a Johnson "Heating-Cooling" Thermostat permits individual weather selection by the occupants. Nearly 2,000 Thermostats and more than 5,900 Johnson Valves, regulating the supply of hot and cold water in modern Carrier Weathermaster room air conditioning units, assure complete year 'round personal comfort for each occupant.

In addition to *individual room temperature control*, behind the scenes there is Johnson Master-Submaster Control to operate valves and dampers to regulate temperatures and humidities of the air supplied by the primary and central air conditioning systems serving the individual room units and the interior zones of the buildings. In the basement areas, other Johnson instruments operate valves and dampers on unit ventilators and exhaust fans.

Gateway Center, involving one of the world's largest automatic air conditioning control systems, is another convincing demonstration that *any* control problem is best solved by Johnson . . . the only nationwide organization devoted exclusively to planning, manufacturing and installing automatic temperature and air conditioning control systems. Ask a Johnson engineer from a nearby branch office for recommendations on any control problem—large or small, in both new and existing buildings. There is no obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

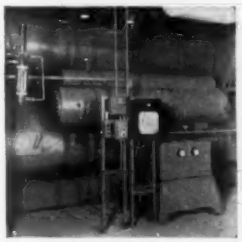
Equitable Life Assurance Society's Gateway Center, Pittsburgh
Architects—Eggers and Higgins, New York, and Irwin Clavan, New York
Consulting Engineers—Meyer, Strong and Jones, New York
Builder—Starrett Bros. and Eken, New York
Air Conditioning Contractors—Kerby Saunders, Inc., New York

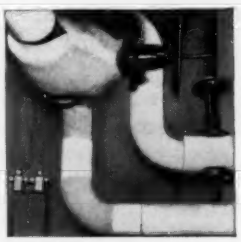




Johnson "Heating-Cooling" Thermostats and Johnson Valves are installed in room air conditioning units throughout Gateway Center. The thermostat, with temperature bulb mounted close behind the recirculating grille, responds quickly to average room temperature. In turn, the Johnson valve regulates the hot and cold water supply to the coil of the unit and automatically applies exactly the right heating or cooling effect.

At right above, J. S. McCorkle, chief engineer of Gateway Center, points to Johnson Humidostat and Johnson Piston Damper Operators on this typical fan installation serving an interior zone of one building. A Johnson Humidostat measures and automatically controls the humidity of the spaces.





At left above is one of three 1500 ton Carrier centrifugal refrigerating machines that furnish chilled water for air conditioning. A Johnson Record-O-Stat (2-pen type) measures and records temperatures of both inlet water and water leaving the chiller. The temperature of the water leaving the chiller is automatically controlled by the Record-O-Stat, which operates the suction dampers of the huge machine.

At right above, Johnson T-901 Submaster Thermostats control Johnson V-88 Steam Valve on district steam supply for hot water converters. Settings for these thermostats are determined by a Johnson T-900 Master Thermostat mounted outdoors. Steam requirements for the three buildings are estimated at 90,000 pounds per hour.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

MANUFACTURING • PLANNING • INSTALLING • SINCE 1885

How Stetson saved 20% with *"that new snap-on pipe insulation"*

By using Gustin-Bacon's new "snap-on" pipe insulation of fine glass fibers, the John B. Stetson Company recently saved 20% on a pipe insulation job in its Philadelphia plant.

The major saving arose from the fact that one maintenance man did the entire installation, while other methods would have required two men. Because of the exceptionally light weight of Gustin-Bacon Ultrafine Pipe Insulation he was able to carry 6′ sections of pipe insulation up the ladder easily. Then he simply spread the section apart at the seam, slipped it over the pipe—and it snapped into place. He secured the seam with staples and binder—no wire or covering was necessary. And lastly, he painted the insulation to improve appearance.

Stetson's cost-cutting experience is typical of that of other industrial leaders across the country. So if you have a pipe insulating job coming up, write today for information. We'll send you samples and complete information on the new pipe insulation that is thermally superior . . . lighter in weight . . . won't break or crumble . . . won't absorb moisture . . . can be easily cut with a knife . . . can be painted. Write *today!*

gb **GUSTIN-BACON MFG. CO.**
243 W. 10th ST., KANSAS CITY, MO.
New York • Chicago • Philadelphia • San Francisco • Los Angeles
Houston • Tulsa • Dallas • Detroit • St. Louis

More TECHNICAL BRIEFS

Begins on page 152

not as detailed as Table I, it does give installed hp, net output, plant load factors, average cost of fuel in cents per gallon (or Mcf for gas) and operating cost as subdivided in Table I. Eighteen plants are reported here for a period of 20 consecutive years; 34 for ten consecutive years. This record shows how high maintenance can affect diesel plants over the long pull.

Table III provides, for each engine, detailed operating information such as:

1. type of engine, cycle, bore and stroke, number of cylinders, speed, rated bhp, year installed
2. hours operated
3. gross output
4. running engine capacity factor
5. peak load
6. bhp at rating and at peak load
7. gallons of fuel oil of Mcf of gas
8. gallons of lubricating oil
9. inspections on fuel used
10. details of cooling system
11. cost of engine repairs, material and extra labor
12. major engine parts replaced
13. number and duration of enforced engine shutdowns
14. total scheduled engine maintenance time
15. number of plant attendants per shift

In the majority of cases, the report presents the foregoing information by engines, but there are certain plants for which this data cannot be broken down. In such cases, plant totals are given. Table III, by correlating the engine with load-fuel-maintenance costs, throws much light on the problem of burning cheaper fuel oils in engines.

No engineer who tries to be competent on diesel power costs can be without this 1953 issue. And to be an authority, he should have as many of the recent past issues as possible, since this report does not repeat all of the past data. The current report costs $2.50 per copy with single copies available to ASME members at $2.00.

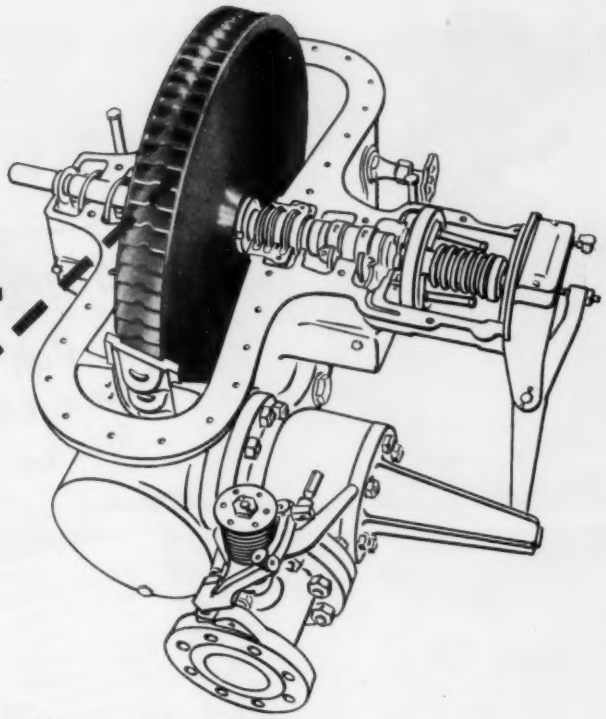
During the 25 years over which ASME has been compiling and publishing diesel power cost data, these reports have gained world-wide acceptance as being authoritative, accurate and indicative. Engineers may differ on interpretation of the data, but no engineer would think of questioning any of the facts presented. *ASME Publication.*

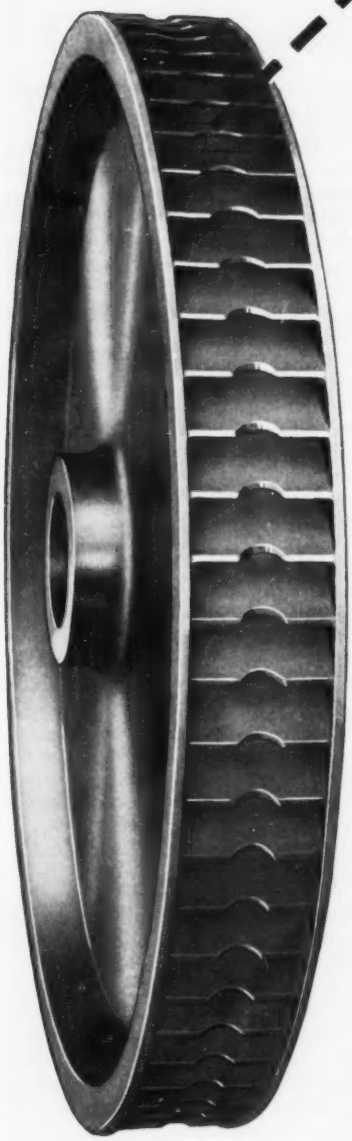
Directions for ordering papers on p 154

Pulsation Absorbers for Reciprocating Pumps. *By E G Chilton and L R Handley, Shell Development Co.*

Pulsation absorbers, or surge bottles,

TERRY SOLID WHEEL





..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1197

GO
on GREEN
as they do at
Unit #1
Potomac Edison Co.
Riverton, Va.
Designed by Sanderson & Porter
2 Green ID Fans design capacity 92,500 cfm, 360°F, 29.92" Bar., 14.2" S.P.; special control type louvre inlet dampers; ring-oiled, water-cooled, self-aligning sleeve bearings; blade liners and scroll liners.
2 Green FD Fans design capacity 55,000 cfm, 100°F, 29.92" Bar., 12.4" S.P.; design 4 A inlet vanes; outlet dampers; inlet screens; ring-oiled, water-cooled, self-aligning sleeve bearings.

The list grows—the list of utility and industrial steam generating plants for which Green Fans were selected to provide the air necessary for combustion purposes.

Draft fans yield to no other equipment in their importance to efficient steaming. They must be properly designed for the requirements in each plant respectively. They must be conservatively rated. And they must be durably constructed.

Green Fans fulfill these basic requirements. You wouldn't find them in so many large utility plants and large industrial plants unless they had thoroughly proved their worth.

Our Catalog No. 168 tells all about Green Fans. Write for a copy.

THE GREEN Fuel Economizer COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cindertrops
- Aerodyne Dust Collectors

BEACON 3, NEW YORK

More TECHNICAL BRIEFS

Begins on page 152

are often necessary in reciprocating-pump installation where pipe vibration, flowmeter errors and other objectionable features of pulsating flow must be reduced or eliminated. Despite simplicity and effectiveness of gas-cushion dampers there are several objections to their use, most important being maintaining gas cushion.

Charging chamber requires gas at a pressure higher than average line pressure. If a membrane is not installed between liquid and gas, liquid will absorb gas. Mixing can be reduced by designing surge chamber so that liquid level is not appreciably agitated. Proper choice of gas will reduce losses by dissolving. A float in surge chamber can reduce contact area between gas and liquid. Where steam or air is available, and slight contamination of liquid with either can be tolerated, a simple automatic control can feed gas into the chamber to maintain a constant cushion.

Where contamination with any gas must be avoided or where pressure gas cannot be supplied to surge chamber, a flexible diaphragm should be used between liquid and gas. Choice of proper diaphragm material presents a problem, for it must withstand chemical action of fluid under continuous flexing and must remain pliable enough so as not to restrain motion of liquid. For hydrocarbons, some synthetic rubbers may be used for diaphragm if it is properly designed.

Do not put restrictions to flow in surge chamber. Restrictions to flow in main line increase pumping power and in general will not reduce pressure pulsations. Restrictions to flow such as orifices, if placed between flow line and the surge chamber, will always reduce effectiveness of chamber.

Graphs are presented, based on theoretical analyses for sizing pulsation absorbers for any pumping installation and any desired pulsation amplitude. Experiments with laboratory units and with plant installations confirm theoretical results. Recommendations are also made for important absorber design details. *ASME Paper No. 53-A-81.*

Directions for ordering papers on p 154

Electrical and Mechanical Features of the Niles Generating Station. *By C E Asbury and J C Beres, Principal Engineers, Commonwealth Associates Inc., Jackson, Michigan.*

Niles Station of Ohio Edison Company, located on the Mahoning River about 15 miles northwest of Youngstown at Niles, Ohio, was designed by engineers of Commonwealth Associates Inc.,

YOU CAN'T SEE WASTE HEAT!

CONTROL OF EXCESS AIR BY CITIES SERVICE HEAT PROVER CAN REDUCE HEAT LOSSES AT CEMENT PLANTS! In cement kilns, air must be controlled to the precise quantity that will just completely burn the fuel. Any excess of air above this amount carries waste heat out of the kiln. THE HEAT PROVER ENABLES THE OPERATOR TO SEE WHEN THE RIGHT AMOUNT OF AIR IS ENTERING THE KILN.

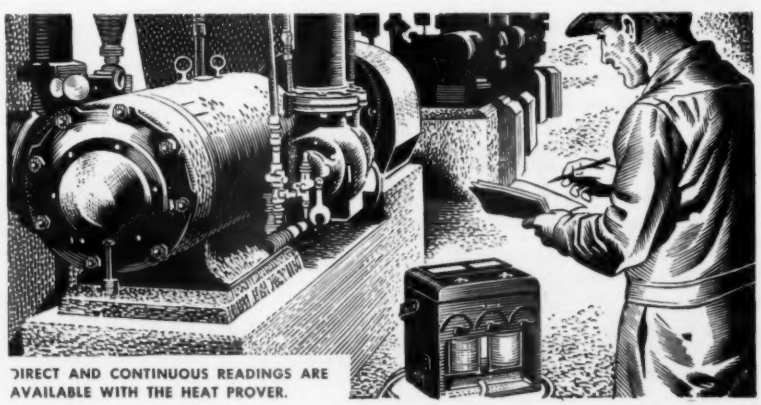
Many air-measuring methods allow only intermittent sampling of kiln gases. With the Heat Prover, direct and continuous readings of kiln combustion are available for immediate use . . . and the Heat Prover can bring about a considerable fuel savings and can substantially increase just about any cement plant's operating efficiency.

WHEREVER A FURNACE OPERATION IS INVOLVED the Heat Prover can help increase productivity and decrease operating costs. It samples rapidly and provides simultaneous and continuous readings of oxygen and combustible gases. The Heat Prover is portable—a technically accurate combustion analysis is obtained in a usable, practical manner. For details call your nearest Cities Service Office or write Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y.

BUT THE CITIES SERVICE HEAT PROVER CAN!

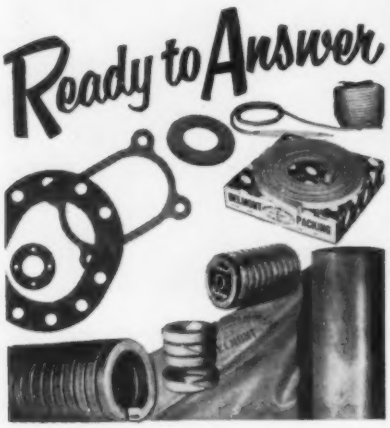
CITIES SERVICE

QUALITY PETROLEUM PRODUCTS



DIRECT AND CONTINUOUS READINGS ARE AVAILABLE WITH THE HEAT PROVER.

BELMONT PACKINGS



Your Hurry Call!

Belmont Packings . . . in spool, spiral, ring, reel, coil and sheet form . . . each in a wide range of specially formulated materials to meet the diverse requirements of modern industry.

Once a routine maintenance job, selection and application of packings is now a specialized field requiring experience, dependability and real devotion to service. HOWEVER, THESE REQUIREMENTS NEEDN'T ADD TO YOUR ALREADY HEAVY RESPONSIBILITIES! There's always a Belmont packings distributor to help you anticipate trouble and . . . when emergencies do arise . . . come to your aid.

That's what we mean when we say that Belmont packings are ready to answer your Hurry Call. They're not only made right . . . they're sold right . . . available when you want them, where you want them . . . through a Belmont Distributor . . . dedicated to YOUR service.

WRITE FOR HIS NAME AND ADDRESS 4-P-1A

for Steam • Water • Oil • Gas • Air Acids • Alkalies • Ammonia

THE
BELMONT
PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pennsylvania

Rings • Spirals • Coils • Reels
Spools • Sheets • Gaskets
There's a Belmont Packing for every service

More TECHNICAL BRIEFS

Begins on page 152

Jackson, Michigan, in collaboration with the client's engineering and operating personnel. It is being constructed by independent contractors under supervision of Ohio Edison Company construction department. The first of the two units is expected to be in operation in near future with second unit following sometime after first of year. Capacity of new station will be 250-mw gross output in two boiler-turbine units.

Site was chosen primarily because of relatively short distance to major load centers. Fuel could also be delivered to site at a cost comparable to that of some other major plants on system. Site consists of 51.4 acres on which are located power plant, substation, coal handling and coal storage. In addition, approximately 50 acres are available for ash storage. Clearing and grading of site involved moving approximately 165,000 cu yd of earth.

Steam generators are Babcock and Wilcox. They are radiant type, water-tube boilers, each with superheater, resuperheater, air heater, and water-cooled, slag drip, cyclone fired, pressure type furnaces. Each has two forced-draft blowers, no induced draft fan, and one flue gas recirculation fan.

Guaranteed continuous output of each steam generator is 885,000 lb of steam per hour at 1485 psi and 1000 F and 785,000 lb of steam per hour at 350 psi and 1000 F at reheater outlet when supplied with 885,000 lb of feedwater per hour at 485 F. Under these operating conditions steam-drum pressure will be 1580 psi, and each unit is designed for a maximum drum working pressure of 1650 psi.

Pressurized furnace of each steam generator is divided into cyclone furnaces, primary furnace and secondary furnace, and is designed with a flooded slag tank ash removal system. Four cyclone furnaces and each generator are located horizontally and fired from two levels. Each cyclone has a 9-ft nominal diameter.

Two constant-speed, vane-controlled, forced-draft blowers serve each unit. These blowers furnish air at high pressure to supply cyclones and keep unit under positive furnace pressure all the way to stack.

Steam generators are equipped with automatic sequential soot blowers using compressed air as the blowing medium. Superheater is in two sections, primary and secondary, with water spray attemperators between sections. Primary superheater, in two vertical banks separated by resuperheater tubes, is located

Directions for ordering papers on p 154

PALMER
MERCURY ACTUATED

DIAL THERMOMETERS

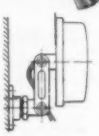
in 3 types to suit any requirements

PATENTED

Full 4½" dial face. Stem can be placed at any angle and case can be rotated to any readable position.

1 **Rigid Stem Dial Thermometer** tapered bulb, interchangeable with standard industrial thermometer separable socket. (As illustrated above.)

2 **Wall Mounted Dial Thermometer** with flexible connecting armor. Case adjustable to easy reading position.



3 **Flush Mounted Dial Thermometer** for panel mounting with flexible connecting armor.

All three types have a full 4½" dial face.

for accuracy: Mercury actuated . . . Fully Compensated by Invar Compensaton. Guaranteed Accurate 1 scale division.

for angularity: Can be adjusted to most readable position at any angle desired.

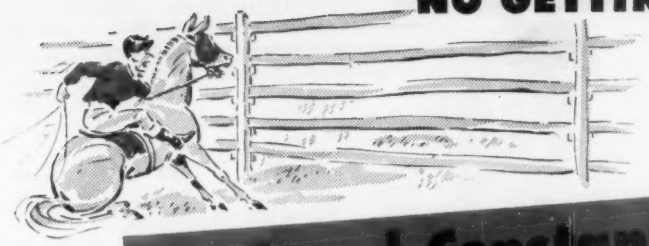
for readability: Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position.

for interchangeability: Always specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

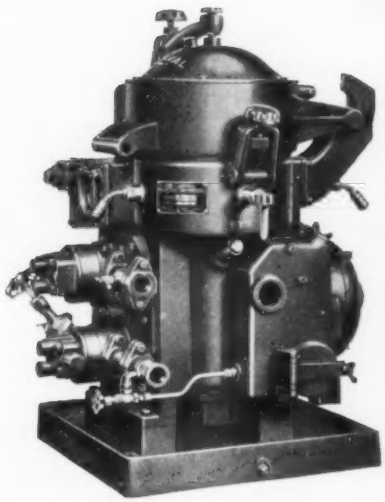
Send for Bulletin 51-129 for details on the New Palmer Dial Thermometer.

PALMER
THERMOMETERS, INC.
Norwood Ave., Cincinnati 12, Ohio
Mfrs. of Industrial Laboratory Recording and Dial Thermometers

NO GETTING AROUND IT!



De Laval Constant Efficiency Bowl Gives You Better, Safer Purification



A De Laval Oil Purifier gets rid of ***both*** contaminants that ruin the usefulness of lubricating oil. The Purifier puts centrifugal force to work to throw out of the oil both solid impurities and water, and thus maintain the oil in a condition best compared with that of new oil.

The manner in which purification takes place within a De Laval is important. The efficiency of purification is constant, from the moment a run starts until the bowl is full of dirt and must be stopped for cleaning. This "constant efficiency" is an inherent advantage of De Laval bowl design. Purification takes place between the discs, whereas dirt thrown out of the oil is stored outside of the zone in which purification takes place. Once it is centrifuged out of the oil, dirt can neither recontaminate the oil nor affect the degree of purification.

You can ***rely*** on De Laval constant efficiency purification.

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

for more dependable power production

These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Valve and Angle Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed. . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

Write for descriptive bulletin

EVERLASTING VALVE CO.
45 Fisk Street, Jersey City 5, N. J.

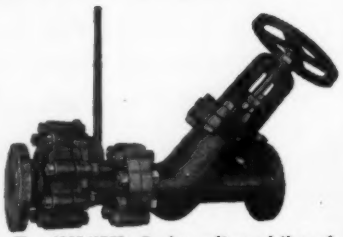


Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Valve and Y Valve.

Fig. 6571/6561. Duplex unit consisting of Y Valve and Angle Valve.

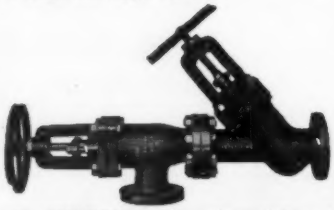


Fig. 6561/6571. Duplex unit consisting of Angle Valve and Y Valve.

Everlasting Valves

Trade-Mark "EVERLASTING" REG. U. S. PAT. OFF.

for everlasting protection

More TECHNICAL BRIEFS

Begins on page 152

in rear pass of the boiler and is arranged for counterflow with respect to gas flow. Secondary superheater, arranged for parallel flow, is located in front pass of unit.

Resuperheater, preceded by water spray attemperators, is designed with counterflow arrangement in two sections. First section occupies center half of rear pass with primary superheater tubes on either side. Resuperheater tubes are separated from superheater tubes by baffle plates. Second section occupies full width of unit with one-half of tubes passing through upper part of rear pass, over top of furnace and down in front of superheater screen. Other half passes up rear of superheater screen, across top of furnace, and down front wall.

Air heater is a vertical, single gas pass, counter air flow, tubular, two vertical-section type. Gases flow upward through tubes and air flows downward around tubes, making five horizontal passes across tubes.

Condensate and feedwater systems for Unit 1 are not interconnected in any way with Unit 2 except that supply from clear well is common to both units. Condensate surges due to varying load are taken in unusually large condenser hotwell. Flow of condensate is through condensate pump, boiler auxiliary cooling-water heater exchanger, feedwater flowmeter orifice, drain cooler, and first, second and third closed type low pressure heaters to three half-sized boiler feed pumps. From boiler feed pumps, feedwater flow is through first, second and third closed-type high pressure heaters, feedwater regulating valve, and thence into boiler drum.

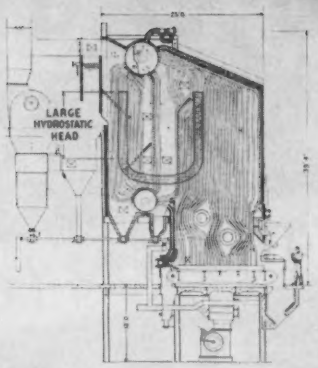
To assure highest quality water for boiler make-up, a monobed demineralizer will use filtered, partially softened water from city mains as a supply. Demineralizer is a duplex installation with fully automatic operation which will provide water having a normal resistivity of 5 to 10 million ohms.

Demineralizers each have a capacity of 100 gpm and are designed to deliver 50,000 gallons of demineralizer water between regenerations. Regeneration of demineralized exchange resins is by means of sulfuric acid and caustic soda stored in 15,000-gallon tanks adjacent to the railroad siding.

Each of the two Westinghouse turbines is two-cylinder, tandem-compound, double-flow, condensing, reheat type designed for operation with 1450 psig, 1000 F steam at throttle valve, 1000 F reheat, and 2-in. Hg exhaust. Guaranteed gross output rating is 125 mw when operating at rated conditions. These

Directions for ordering papers on p 154

Add the Advantages...



5. LARGE HYDROSTATIC HEAD

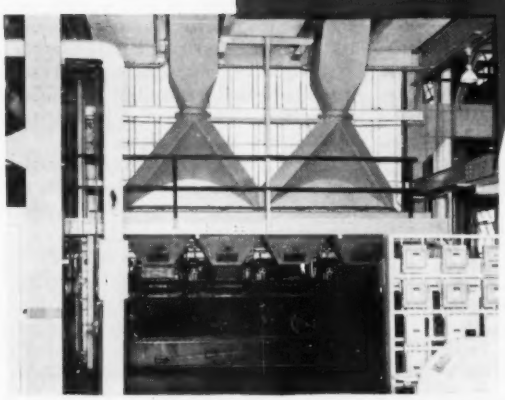
+

6. RAPID CIRCULATION

=

In addition to advantages described and illustrated in previous ads, BROS offers these two features which together help you maintain high watertube boiler efficiencies consistently. Since you can't expect effective heat transfer from tubes to sluggishly moving water, BROS provides a larger hydrostatic head which circulates water at greatest practicable velocities. This rapid circulation means truly economical steam generation and cooler tube surfaces, an important safety factor.

You'll Choose BROS



This is a BROS 4-drum Watertube Boiler installation at a large midwestern utility. This plant generates electric power for consumers in the area.

Before you specify your next steam generating unit, talk to a man from BROS. He can tell you concisely what a BROS-designed watertube boiler offers you. Two of the points are illustrated above. Since 1888 BROS engineers have specialized in these features which make boilers deliver the most steam for the least money in a specified application. Many of these BROS advantages are exclusive. Find out how they can serve you!

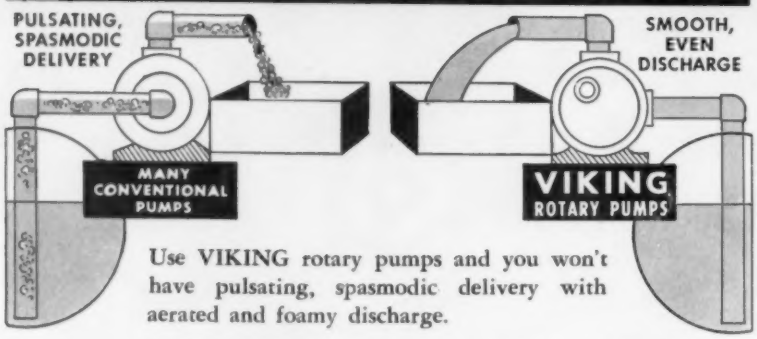
Third in a series of ads describing BROS advantages, point by point. ADD THE ADVANTAGES . . . YOU'LL CHOOSE BROS!

BROS

Power Division: **WM. BROS BOILER & MFG. COMPANY**
1057 Tenth Ave. S. E., Minneapolis 14, Minnesota

DESIGNERS AND MANUFACTURERS OF 2, 3 AND 4 DRUM WATERTUBE BOILERS, SUPERHEATERS, AIR HEATERS, ECONOMIZERS, ACCESSORIES, AUXILIARIES, PLUS A FULL LINE OF HEAVY-DUTY STOKERS

IF YOU WANT SMOOTH PUMPING



Use VIKING rotary pumps and you won't have pulsating, spasmodic delivery with aerated and foamy discharge.

With VIKINGS, you have fast, smooth priming and constant, even discharge of the liquids from beginning to end.

You can also handle not only thin, gaseous liquids, but heavy, viscous liquids as well. And all can be handled with excellent results.

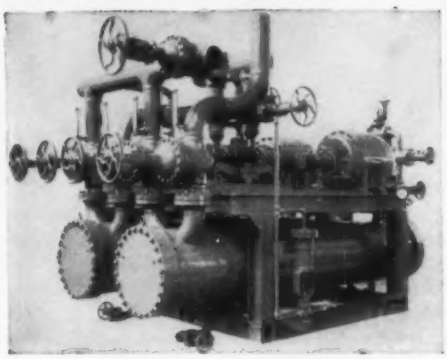
VIKING AN HONORED NAME IN PUMPING

Ask for further details today. Bulletin 54SW sent promptly on request.

See Our Catalog In SWEET'S

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

LOCKETT FUEL OIL PUMPING AND HEATING SETS



The compact, high-pressure Unit illustrated here was built for a large Utility Station in the South West. It consists of two Motor-driven Pumps and two Shell - and - tube - type Oil Heaters mounted on a single frame. Each pump is designed to handle a capacity of 55,000 pounds per hour of bunker fuel oil, against 300 P.S.I.

Custom Built

For almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built, Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump-and-heater is suitable for the full rated capacity of the unit; the second pump and heater are spares. Lockett supplies everything, complete. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

More TECHNICAL BRIEFS

Begins on page 152

turbines drive hydrogen cooled generators rated 125 mva, .85 pf at 0.5 psi hydrogen pressure and 156.25 mva at 30 psi hydrogen pressure.

Centralized air - conditioned control room for operation of the turbine-generators and steam generators is on turbine floor level in space between them. Room houses controls for Units 1 and 2 and also for 138-kv substation. Pump panels located in basement constitute only other control point provided in powerhouse.

Desired final superheater and resuperheater steam temperatures are maintained by automatic control of (1) recirculating gas fan inlet dampers, (2) proportioning dampers for gas flow between bank of superheater and bank of resuperheater tubes, and (3) water spray type attemperators. Various combinations of these three controls are used, depending upon load.

Recirculating gas fan recirculates gases from boiler outlet back into primary furnace. Control of quantity of gas being recirculated is effected at the lighter loads in order to increase both superheat and reheat temperatures above those which would exist without gas recirculation. When either superheat or reheat temperature has reached control point of 1000 F, further increase is prevented by proportioning gases passing over reheat superheater and primary superheater by means of proportioning dampers.

Spray type attemperators located between secondary and primary superheater sections maintain final steam temperature leaving secondary superheater at 1000 F when operating boiler at a high range where recirculating fan damper is completely closed. Spray type attemperators are located in reheat line from turbine to control final reheat steam temperature at 1000 F when operating boiler in extreme high range and when reheat proportioning dampers are at their set limit. The over-all automatic temperature control is modified by air flow to boiler, thereby anticipating changes in combustion rate.

In low-load range of boiler operation, gas recirculation is at a maximum. Difference between superheat and reheat temperatures will be held to zero by control of proportioning dampers. In intermediate load range when recirculating damper has reached closed limit, on load increase reheat steam temperatures will be controlled by gas proportioning dampers while secondary superheater outlet steam temperature will be controlled by spray attemperation. When reheat proportioning damper reaches its closed position control will be affected by spray attemperation. *AIEE Conference Paper, unavailable.*

INCREASE HORSEPOWER CAPACITY 40%

. . . and give you more use per dollar

The combination of new synthetic fibers in the strength member of R/M Super-Power V-Belts assures greater resistance to shock loads, virtually no stretch, and practically eliminates matching problems. This, along with our straight side-walls, means better tensioning and grip, less slippage . . . more power delivered on the drive. Compared with regular V-belts you can handle approximately 40% greater load with the *same number* of R/M Super Power V-Belts or do an equal job with *fewer*.

Another plus . . . these V-belts are oil-proof, non-spark and heat-resistant. Send for Bulletin 6628. Ask the R/M distributor to show you how R/M Super-Power V-Belts will deliver "More Use per Dollar" on your drives . . . Condor V-Belts continue to be the standard for regular service.

RM

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

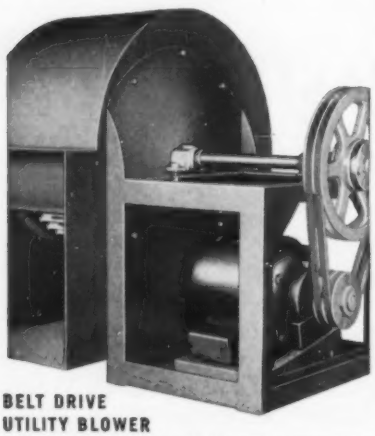
Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Bowling Balls

BIG OR SMALL

Air-moving problems solved economically with *Peerless* BLOWERS

DIRECT DRIVE UTILITY BLOWER

Compact; easy-to-mount; quiet; arc-welded; weatherproof covers; matched motor; fully guaranteed by Peerless.



BELT DRIVE UTILITY BLOWER

Arc-welded; sleeve or ball-bearing; convertible housing; adjustable speeds; fully guaranteed by Peerless.

● Let your Peerless dealer show you how to move smoke, fumes, or dirt and dust laden air from your plant or shop economically. He knows his business and gets additional help from our engineers. Initial low cost and trouble-free service assure long-time satisfaction. You can't buy better than Peerless. Write for dealer nearest you.

Peerless Electric

THE PEERLESS ELECTRIC COMPANY
FAN AND BLOWER DIVISION
1417 W. MARKET ST. • WARREN, OHIO

My Biggest Boner

► SERIOUS boners sometimes remind the power-plant operator of the tremendous amount of energy he controls. A recent boner did just this for me, and telling other operators about it may prevent a similar mishap.

Six months ago we put in eight 200-hp 1000-cfm air compressors to serve process and maintenance loads. Construction lagged a bit during the final stages so tests of the new compressors had to be made in a hurry. This was my job, and, to be sure the tests would go smoothly, I had two operators check the entire installation—motors, piping, receivers, safeties, drains, etc.

Next morning we started the units one after another. When the last one went on the line I beamed proudly. This was the sweetest running job I'd seen in a long time. But suddenly, there was a terrific crash. I turned just in time to see a large loading door buckle inward. Glass shattered as windows, too, caved in.

We soon found the trouble: compressor suction lines had not been run outdoors. The contractor had figured this could be done later, but our eight compressors evacuated the tightly closed building and sucked in doors and windows. The moral: Inspect new units at least twice before starting. Don't rely too heavily on others!

DON KELLAND
New York, N. Y.

● What is your "biggest boner"? We'll pay ten dollars for each one we publish.

Westinghouse Electric Corp is building a $2-million plant in Harmar Township, Pa. The new installation, a part of the Co's Atomic Power Division, will produce component parts for atomic power plants.

FOR *Complete* TURBINE OIL CONDITIONING

THE HILCO OIL RECLAIMER

REMOVES WATER, SLUDGE, ACIDS . . .

IT IS CONTINUOUS AND AUTOMATIC . . .

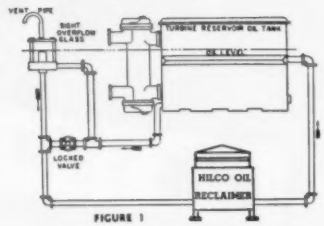


FIGURE 1

The HILCO system results in removing contamination as fast as it is formed, thus maintaining the oil in first class condition.

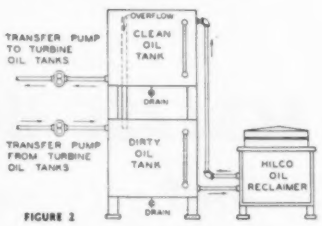


FIGURE 2

The HILCO OIL RECLAIMER is self-contained, including built-in pumps, electric heaters, starters and controls. It is compact, easy, and quick to service.

FOR MORE INFORMATION ON THE HILCO SYSTEM . .

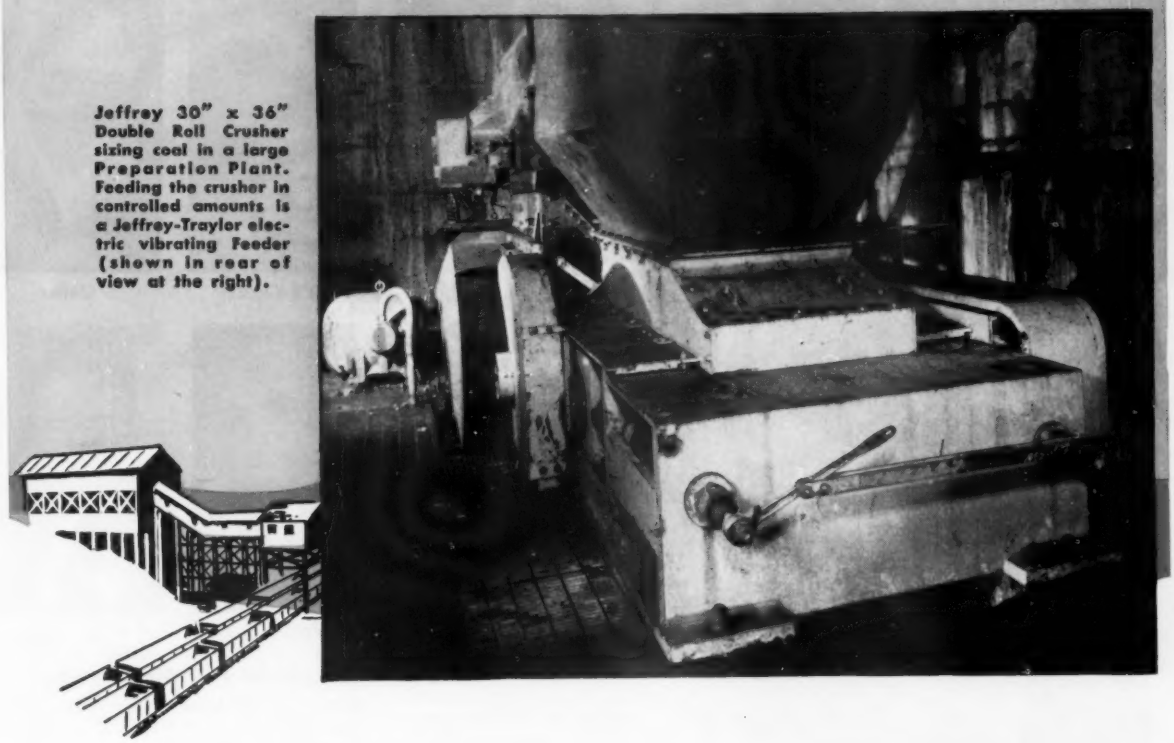
WRITE FOR THIS FREE BOOKLET TODAY!

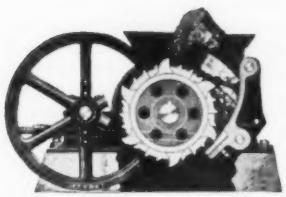
THE HILLIARD CORPORATION
159 W. FOURTH ST. ELMIRA, N. Y.

IN CANADA: Upton - Bradeen - James, Ltd
990 Bay St., Toronto—3464 Park Ave., Montreal

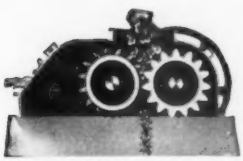
COAL SIZING NO PROBLEM

Jeffrey 30" x 36" Double Roll Crusher sizing coal in a large Preparation Plant. Feeding the crusher in controlled amounts is a Jeffrey-Traylor electric vibrating Feeder (shown in rear of view at the right).

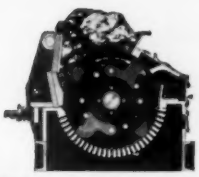




Cross-section of Jeffrey Single Roll Crusher. Reduces lump coal to 1½" and larger in one operation.



This cross-section shows a Jeffrey Double Roll Crusher, a unit which will handle entire mine output without preliminary sizing or picking. Product range from 4" to 12".



FLEXTOOTH Crusher sectional view. Takes lump coal up to 24" and reduces it to stoker size in a single operation.

Reciprocating Plate Feeders	V-Bucket Elevator Conveyors	Rotary Ring Crushers
Electric Vibrating Feeders	Pulverizers	Bin Valves
Mechanical Feeders	Track Hoppers	Chains and Sprockets
Belt Conveyors	Bucket Elevators	Weigh Larries
Spiral Conveyors	Car Pullers	Drag Chain Ash Conveyors
Apron Feeders	FLEXTOOTH Crushers	Skip Hoists

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

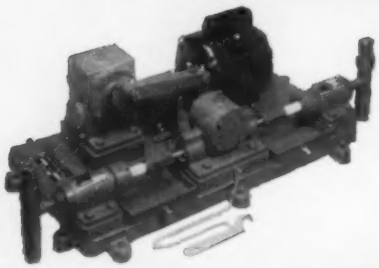
PLANTS IN CANADA, ENGLAND, SOUTH AFRICA.

IF IT'S MINED, PROCESSED OR MOVED

. . .IT'S A JOB FOR JEFFREY!

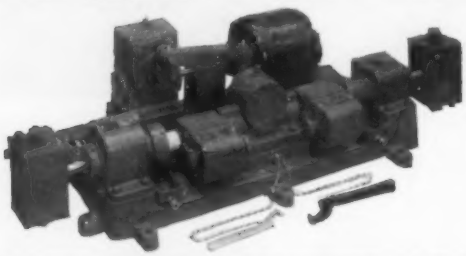
If you meter or proportion small volume flows...

THERE IS A HILLS-McCANNA "U" TYPE PUMP TO DO THE JOB



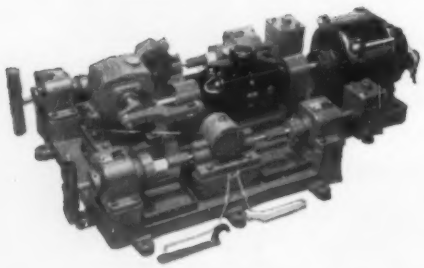
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



JACKETED UNITS

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



VARIABLE SPEED UNITS

"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

Write for Catalog:

Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" Type Pumps. Write for a copy, today. Hills-McCanna Co., 2369 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

Also Manufacturers of:
SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

APPOINTMENTS

H A Kammer

G Claytor

S N Fiala

T T Frankenberg

Corporation Executive Changes

American Gas & Electric Service Corp: Graham Claytor, executive vice-president, operating; H A Kammer, executive vice-president, engineering and construction; V M Marquis, vice-president and assistant to the president; S N Fiala, chief engineer; F A Lane, deputy chief engineer; H P St Clair, planning and operating engineering manager; T T Frankenberg, mechanical engineer; F M Porter, electrical engineer; J H Kingborn, deputy electrical engineer; G W Bice, assistant mechanical engineer; H F Hoebel, assistant electrical engineer; J E Geue, operating manager, production.

American Brake Shoe Co: Kempton Dunn, president. **Minneapolis-Honeywell Regulator Co:** Charles B Sweatt, vice-chairman of the board; Tom McDonald and A M Wilson, executive vice-presidents. **Davis Engineering Corp:** A O Jaeckel, president. **Gibbs & Hill, Inc:** David B Sloan, president; Edward H Anson, senior vice-president; John B Saxe, vice-president and chief engineer. **Wallace & Tiernan, Inc:** F G Merckel, president; R M Jackson, executive vice-president; G D Peet, vice-president in charge of product engineering and development.

New Sales Vice-presidents

Pyrene Manufacturing Co: Maynard A Laswell. **Fluor Corp, Ltd:** James P Kneubuhl, eastern area. **Eutectic Welding Alloys Corp:** Fred F Roehll.

New Sales Managers

American Brake Shoe Co: Harold C Osborne, industrial equipment. **Potter & Brumfield:** Zeke R Smith, Chicago office. **Graybar Electric Co:** August Stang Jr,

STOWE Stokers

9 units installed under existing boilers

at U. S. STEEL'S Clairton Works

reduce smoke and fly ash

help make a cleaner, better Allegheny County

● **U. S. STEEL** is justly proud of the contribution it is making in its program of reducing smoke and fly ash in this area. And we, of The Johnston & Jennings Co., are proud of the performance of the 9 Stowe Stokers recently installed in the Clairton Works.

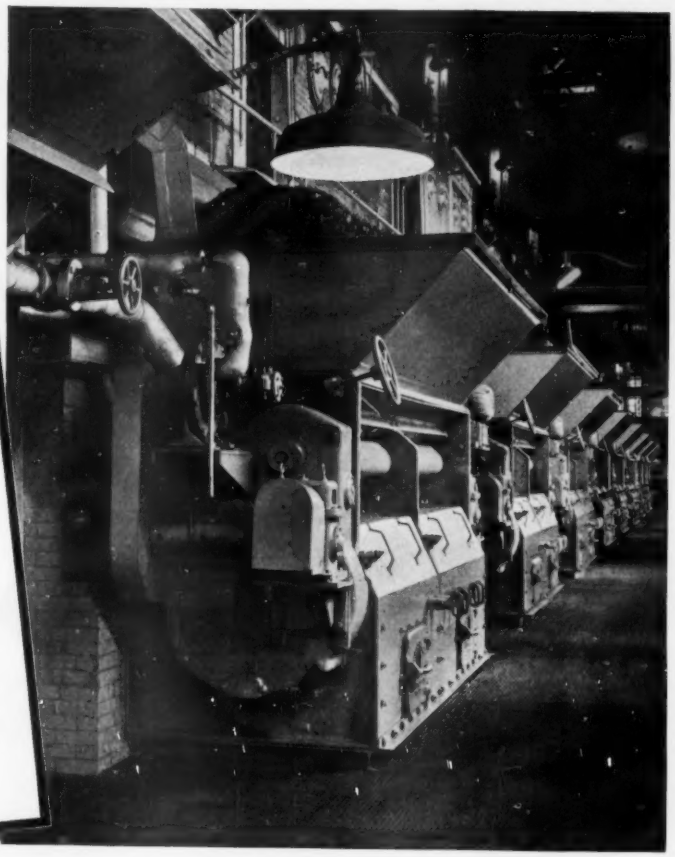
THESE 9 STOWE STOKERS, each installed under an existing boiler, reduced a smoke and fly ash problem. Stacks of these same boilers are now conforming fully to the requirements of the Allegheny County Smoke Control Ordinance — without requiring the installation of any smoke or fly ash collectors.

PRODUCE MORE STEAM

The Stowe Stokers increased the output of the 9 boilers from a maximum of 16,000 to 18,000 lbs. per hour each to 40,000 lbs. per hour each — more than double — and at the same time effected a very material cut in steam costs.

PROVEN DESIGN

Correct burning rates per sq. foot of grate area; — even depth of fuel bed from side to side and front to rear; — and uniform air distribution — no suspension burning — are some of the reasons Stowe Stokers perform so well. Send for Bulletin No. 501. Let us help **you** eliminate smoke, increase the steam output of existing boilers, and cut steam costs in **your** plant.

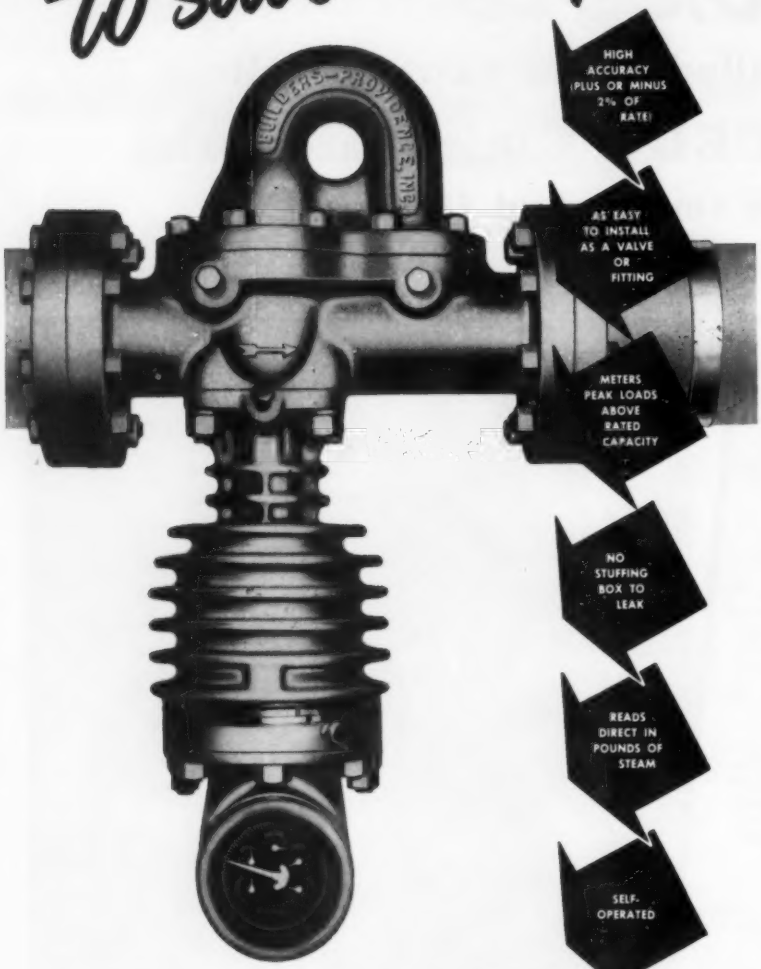


"More Power to You" with **STOWE Stokers**

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio

.... *Division of* PETTIBONE MULLIKEN CORP...

Meter Steam to save money!


HIGH ACCURACY (PLUS OR MINUS 2% OF RATE)
AS EASY TO INSTALL AS A VALVE OR FITTING
METERS PEAK LOADS ABOVE RATED CAPACITY
NO STUFFING BOX TO LEAK
READS DIRECT IN POUNDS OF STEAM
SELF-OPERATED

Install BUILDERS SHUNTFLO STEAM METER right in the steam line like a valve or fitting. Get accurate steam consumption figures in pounds on the direct-reading meter dial. Shuntflo Steam Meters available in two styles: Model SMKS (shown) for 2" to 14" lines — Model SMDH for 1" and 1½" lines. Write for Bulletins. Builders-Providence, Inc. (Division of B-I-F Industries), 354 Harris Avenue, Providence 1, Rhode Island.

BUILDERS

PIONEERS IN METERS AND CONTROLS

More APPOINTMENTS

Begins on page 245

Allentown branch. **E D Bullard Co:** Joseph L Polizoto, Los Angeles office. **Baldwin-Hill Co:** David M Williamson, area manager, industrial sales. **Darling Valve & Mfg Co:** Bertil E Engstrom, midwest region. **Illinois Gear & Machine Co:** Richard H Ewert. **National Research Corp:** George A Goetz, new Cleveland office. **Baldwin-Lima-Hamilton Corp:** Kenneth A Ayers, Washington office.

New Sales Engineers

General Electric Co: Harold A Sample, New England district of Carboloy Dept. **Trane Co:** Phillip D Freeman, St Paul office; Richard E Jameson, Des Moines office; Dennis W Nelson, Billings, Mont. office. **Boston Woven Hose & Rubber Co:** George A Ryan, plastic division. **Scaife Co:** W T Bryson, southeast district; Frank F Brown, New York territory. **National Supply Co:** Walter C Severin, Portland office.

Engineer Changes

Tuthill Pump Co: Robert Von Rotz, chief engineer. **Grinnell Co, Inc:** Helmut Thielsch, metallurgical engineer, industrial piping division. **Ohio Machine & Boiler Co:** Everett C Gosnell, chemical engineer.

New Representatives

For **Kewanee-Ross Corp:** Debco Equipment Co, Inc of 6219 Delmar Blvd, St Louis 5, Mo. For **Orr & Sembower, Inc:** Charles M Setzer & Co of Charlotte, N. C. For **Detroit Stoker Co:** Craig Equipment Co of 1526 Farmers Bank Bldg, Pittsburgh 22, Pa. For **Rivett Lathe & Grinder, Inc:** Ficke Engineering & Supply Co of 305 Pattie Ave, Wichita 7, Kans. For **Bamfords, Ltd:** International Selling Corp of New York. For **Sims Pump Valve Co:** Nutmeg Industrial Supplies, Inc of New Haven, Conn.

For **Drayer-Hanson, Inc:** E M Paulin, Inc of Buffalo, N. Y. For **Fielden Instrument Division, Robertshaw-Fulton Controls Co:** Hoyt-Grant Co, Inc of New Haven, Conn; Nick Ruge Sales Co of 1001 E New York St, Indianapolis, Ind; K P Knudsen & Co of 305 Techwood Dr, Atlanta 3, Ga. For **Penn Industrial Instrument Corp**. Snyder Co, Inc of Tulsa, Okla. For **Preferred Utilities Mfg Corp:** Nevans Co of Houston, Texas. For **Kuhlman Electric Co:** D S MacCorkle Sales Co of 1 Newark St, Hoboken, N. J.

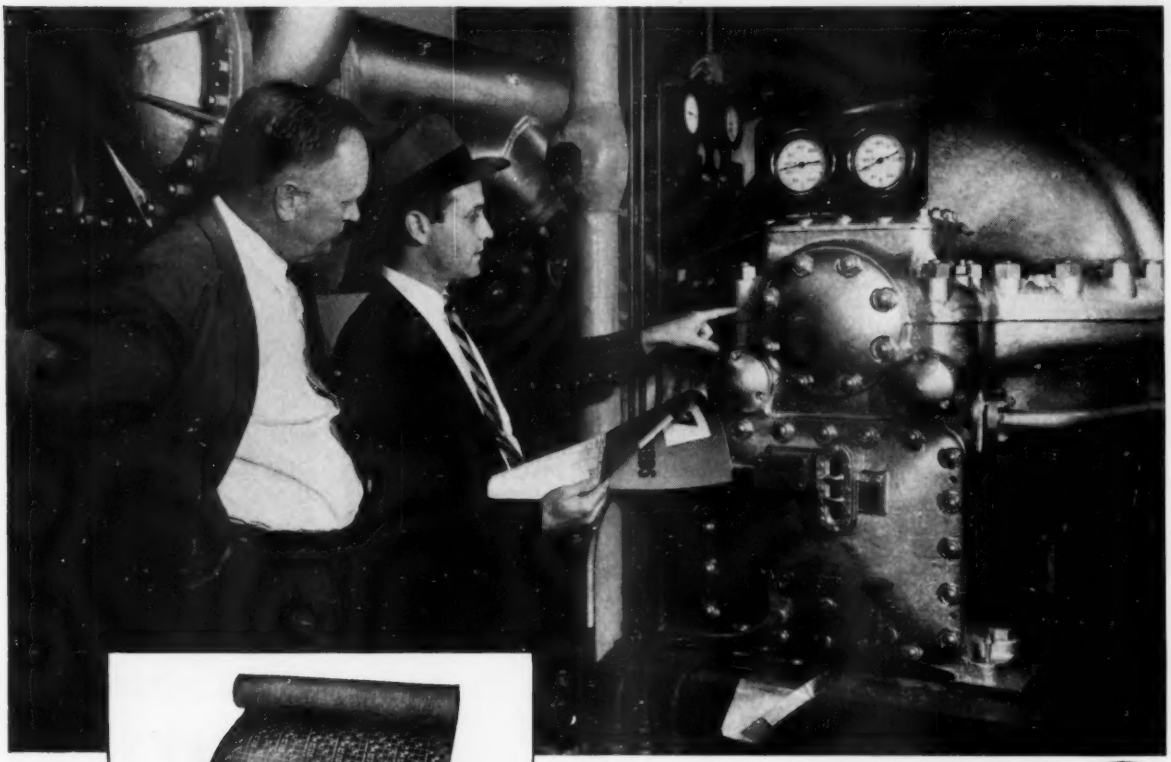
Institute Elections

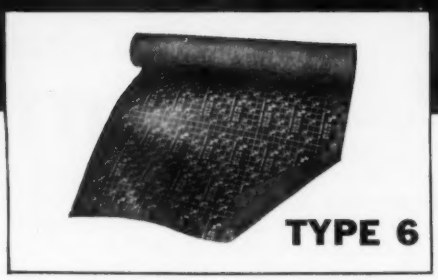
National Constructors Assn: John F O'Connell, president. **National Conference on Industrial Hydraulics:** Carl E Schmitz, director. **Engineers Join Council:** Dr Thorndike Saville, president.

Awards

William H Rowand: The Newcomen Medal for achievement in the field of steam. **John Findley Peters:** The 1953 Edison Medal for "his contributions to the fundamentals of transformer design, his invention

R/M's BIG 7 Packing Types meet 95% of all packing needs





Centrifugal compressors like this one, which is used to air-condition a huge office building, give top performance with R/M Packing No. K-68, a gasket material included in Type 6 of R/M's "Big 7" Packing Types.

Let R/M lower your packing inventory

If you are under the impression that you must stock 10, 20, 50 different types of packings, get acquainted with the distributor who sells R/M's "Big 7" Packing Types. R/M's "Big 7" Packing Types have so simplified the whole packing picture that your plant can probably standardize on just three or four. This basic line of just seven field-tested packing types is engineered to give custom-built performance in all but the very rarest packing applications. It can reduce your down-time, cut your maintenance costs, simplify your ordering. Call in your R/M distributor today.

R/M PACKINGS FOR MAINTENANCE PURPOSES ARE SOLD ONLY THROUGH AUTHORIZED R/M DISTRIBUTORS

R/M

RAYBESTOS-MANHATTAN, INC., PACKING DIVISION, MANHEIM, PA.

BIG 7 PACKINGS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

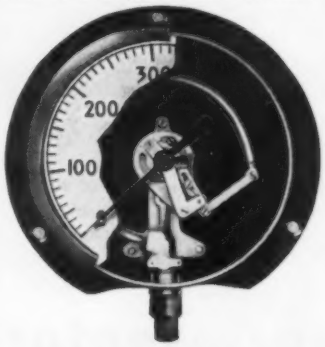
Lonergan

PRESSURE GAUGES

PROVEN
Dependable
AND
Accurate

IN POWER PLANTS AND OTHER INDUSTRIAL SERVICES

Lonergan Pressure Gauges are known everywhere for their reliable performance on a wide variety of services and thousands of installations. They have undergone *continued* improvements in design and construction over the last half century that have kept them always abreast industry's technical advances.



THERE'S A LONERGAN GAUGE FOR EVERY APPLICATION

This most extensive line includes some 18 types of gauges, more than 100 models and 16 case styles. Sizes range from 2½" to 12" diameter. Your local Lonergan representative can discuss your gauge problems completely. Consult him.

FOR FULL INFORMATION
GET OUR CATALOG

Full facts and figures are given in our gauge Catalog 800 G. Send for a copy on your business letterhead.

Lonergan

J. E. LONERGAN COMPANY
Race and Second Sts., Phila. 6, Pa.
Over 80 years experience

More APPOINTMENTS

Begins on page 246

of the Klydonograph and his contributions to military computers." **Walter L Fleisher:** The F Paul Anderson Medal for "outstanding contributions to the advancement of heating, ventilating and air-conditioning."

Obituaries

David Moffat Myers, 75, consulting engineer, January 20th. Mr Myers began his career as Mechanical Engineer for U. S. Leather Co from 1901 to 1906 and was in private practice from 1906 until 1915. He was a partner in the firm of Griggs and Myers, a member of the firm of Orrok Myers and Shoudy, a partner in the firm of Myers Fuller and Addington. At the time of his death, he was Consultant with the firm of Seelye Stevenson Value & Knecht.

Stirling Murray Rust, 72, chairman of the board and founder of The Rust Engineering Co, January 29th.

Reginald H Hargrove, 57, president of Texas Eastern Transmission Corp, January 10th.

Dr Karl B McEachron, 64, General Electric lighting expert and internationally known pioneer in man-made lightning and high-voltage phenomena, January 24th.

More POWER NEWS

Begins on page 150

1500 psi Steam Plant—Design and Operating Aspects; Automatic Mixed-bed Demineralizing at the Niagara-Mohawk Power Co; The Expected Life of Anion Exchangers Under Various Conditions of Deionizer Design and Operation.

INDUSTRIAL POWER PLANTS — Economic Aspects: Economic Factors Affecting Selection and Replacement of Power Plant Equipment; Hawthorne Power Plant Rehabilitation Economics.

Friday, March 26, 1954

NUCLEAR ENERGY: Economic Aspects of Various Types of Nuclear Reactors; Technology of the Use of High-pressure Water for Reactors; Problems of Operation of Nuclear Power Plants.

WATER TECHNOLOGY: Water Problems in the Nuclear Power Field; Boilers and Boiler Water; Silica Removal by Salt Splitting Without Demineralization; Some Chemical Aspects of Hot Process-hot Zeolite Plant Performance.

GAS TURBINES: Gas Turbines for the Power Industry; A New Power Cycle Combines Gas Turbine with Steam Turbines; Factors Associated with Use of Gas Turbines for Automotive Applications.

CENTRAL STATION STEAM POWER PLANTS: Supercritical Pressure Steam Power Cycles; The Economy of Large Generating Units.

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IF you are responsible for the efficient operation of air conditioning equipment, send for a FREE copy of this handy little booklet.

It tells you what to do about lime scale. How to get rid of it. How to prevent it from forming. And the booklet discusses that other enemy of efficiency . . . slime. Describes simple, low-cost ways to prevent it from fouling up lines, tanks and spray jets.

Other items of interest: Cleaning finned coils of air washers, cleaning aluminum plates and screens, descaling cold diffusers, cleaning filter screens.

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Unloading 1200-TON BARGES

in less than 90 minutes

(including clean-up)

This new Mead-Morrison 10-ton stationary coal tower, recently installed at Commonwealth Edison Company's Ridgeland Station, was designed for a free digging rate in excess of 1200 tons per hour from barge to hopper.

The use of a Mead-Morrison lightweight coal grab and a Mead-Morrison barge haul system contributes to this outstanding performance.

One of the features of this machine is an extended cantilever at the rear, allowing coal to be put in storage and to be reclaimed from storage to conveyer belt or barge. Power to the hoist drums is supplied by wound-rotor motors and counter-torque, full-magnetic, reversing, alternating current control for 4160 volts.

Mead-Morrison Coal and Ore Handling Bridges and Unloading Towers are available in capacities up to 2000 tons per hour. They have proven their efficiency and dependability for over 50 years in installations all over the world. Be sure to consult Mead-Morrison on your material unloading and rehandling problems.

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Division of
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These bottles contain samples of dust from the stacks of hundreds of industrial plants.

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MECHANICAL ELECTRICAL *20 Years of Engineered Efficiency in* **DUST COLLECTION SYSTEMS**

More POWER NEWS

Begins on page 150

CORRECTION

In a news report "Britain Tests Revolutionary Wind Generator," page 154, January POWER, there is a statement to the effect that the wind turbine installed on Grandpa's Knob in Vermont had been running three weeks, when a high wind began to rock the tower and broke off one of the blades. The facts are: This unit of 1000-kw capacity went on test October, 1941, and remained so for more than a year, operating on the system of the Central Vermont Public Service Corp.

At the end of that time, an anti-friction bearing on the main shaft failed. Because of wartime shortages, the bearing could not be replaced until March 3, 1945. The unit was then put back into operation and ran until March 26 without interruption, when one of the two blades failed in a spar connection. During the 3½ years after the unit first went on test, it operated a total of 838 hr on load and 192 off line under test and generated 360,000 kwhr.

Coming Events

Mar 4-5—American Society for Metals, mid-winter meeting, Hotel Statler, Boston, Mass. For details write ASM, 7301 Euclid Ave, Cleveland 3, Ohio.

Mar 10-12—American Society of Mechanical Engineers, international meeting, Hotel Del Prado, Mexico City. For details write ASME, 29 W 39th St, New York 18, N. Y.

Mar 11-13 — Air-conditioning and Refrigeration Institute, educational conference, Municipal Auditorium, Long Beach, Calif. For details write ARI, 1346 Connecticut Ave NW, Washington, DC.

April 26-29—Rural Electrification Administration, annual conference, Hotel Melbourne, St Louis, Mo. For details write H F Collins, secy for the conference, PO Box 186, Pittsfield, Ill.

May 3-5—Air Pollution Control Assn. annual meeting, Patten Hotel, Chattanooga, Tenn. For details write R T Griebling, exec secy, APCA, 4400 Fifth Ave, Pittsburgh 13, Pa.

May 5-7—American Welding Society, welding and allied industry exposition, Memorial Auditorium, Buffalo, N. Y. For details write Banner & Greif, 18 E 41st St, New York 17, N. Y.

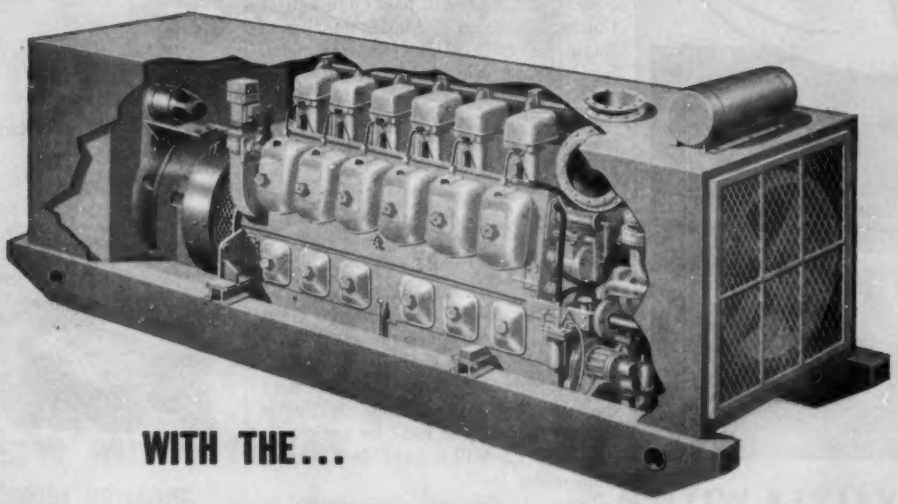
May 10-14—Human Engineering Institute, Stamford, Conn. For details write Dr B J Covner, director, Human Engrg Institute, Dunlap & Associates, Inc, 429 Atlantic St, Stamford, Conn.

Sauerbrunn Retires from B&W

► E S Sauerbrunn, top sales manager for Babcock & Wilcox Co, has retired as manager of the Cincinnati District Office. At a farewell party in Cincin-

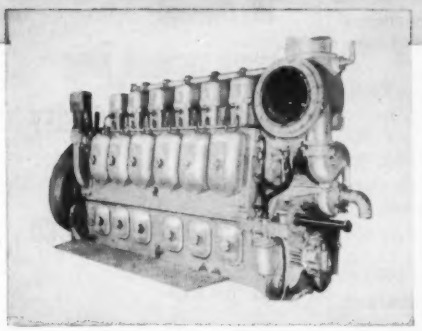
DEPENDABLE POWER

WHERE YOU WANT IT, WHEN YOU WANT IT



WITH THE...

NEW, PORTABLE ALCO DIESEL ELECTRIC GENERATOR UNIT



Alco 6-cylinder, 9" x 10½" (251-A), 4-cycle, turbocharged diesel engine, dry weight 21,350 lbs. Twelve- and 16-cylinder engines also available.

for

- ★ Emergency power generation
- ★ Power during construction or repair
- ★ Supplemental power during peak periods
- ★ Hospital or civil defense standby service
- ★ Scores of other municipal and industrial uses

Here's the answer to your demand for a compact, economical power generating unit for emergency, temporary or standby service.

A completely self-sufficient power plant, the new, portable Alco Diesel Electric Generator unit consists of a 9" x 10½", 4-cycle turbocharged Alco diesel engine, in sizes ranging from 390 to 1300 kw, with all necessary auxiliary equipment.

It can be rail-mounted for electric power *where* you want it, *when* you want it. It can be installed permanently for applications such as standby service in hospitals and municipal power plants.

Either way, it puts dependable power at your immediate call twenty-four hours a day.

ALCO DIESELS

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SCHENECTADY, N. Y.

AMERICAN LOCOMOTIVE COMPANY
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Please send me complete information about the new Alco Portable Diesel Electric Generator Unit.

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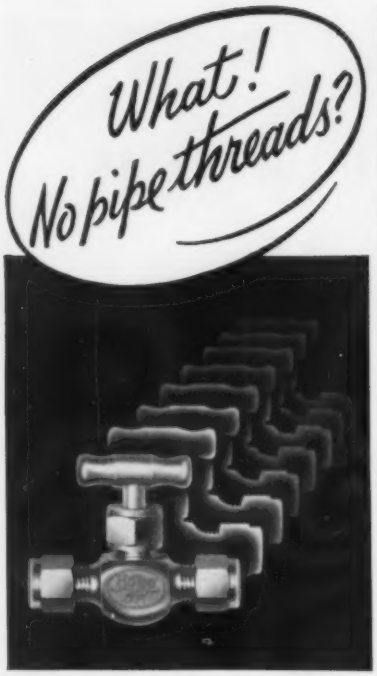
City_____ Zone____ State_____



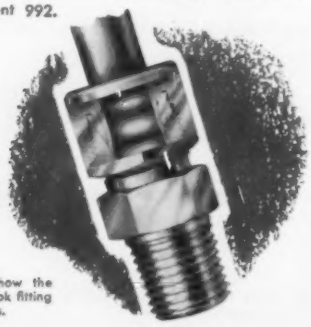
HOKE VALVES WITH

Swagelok®

ENDS

Now they are available from stock at Crawford Fitting Company and all Swagelok Distributors. These valves, manufactured by Hoke, Incorporated, Englewood, N. J., are equipped with Swagelok ends to provide leakproof and torque-free seals on every type of instrumentation installation. The arrow on the valve body shows direction of flow.

Hoke valves equipped with Swagelok ends are made in brass, aluminum, steel and stainless steel in sizes to meet your requirements. For further information and Swagelok catalog address Department 992.



Here's how the Swagelok fitting functions.

CRAWFORD FITTING CO.
884 East 140th Street Cleveland 10, Ohio
Teletype CV-785

More POWER NEWS

Begins on page 150

nati, the company awarded Sauerbrunn a gold watch and a certificate of appreciation for his 33 years of service.

The retiring B&W man is a life member and past president of the Engineers Society of Cincinnati, past chairman of Cincinnati section of ASME, member of Engineers' Club of Dayton, Newcomen Society and National Association of Power Engineers. Succeeding Sauerbrunn as manager of the Cincinnati district is John G Martin, former assistant manager.

Some Pros and Cons On Atomic Energy

• NUCLEAR POWER will definitely be available some day for civilian use, but before that takes place there will have to be considerable probing in the laboratory, the cost-accounting office and the courtroom. The reason for this is that three questions must be answered: Can it work? Will it pay? Is it permissible under law?

These are the conclusions reached in an article in ASME official publication, *Mechanical Engineering*. This article lists ten types of reactors that have been tested for power applications. Most promising for the future are converters providing heat with either ordinary water or "heavy water."

• OAK RIDGE SCHOOL of Reactor Technology is now accepting applications for 1954-55 session. Applications for the class beginning in September must be submitted for review by the Committee on Admissions not later than March 15, 1954. Overall objective of this school is "to educate selected students in reactor technology and in the application of basic sciences, applied sciences and modern engineering techniques to the design and development of reactor systems and their components." Further information and application forms are available from Oak Ridge School of Reactor Technology, PO Box P, Oak Ridge, Tenn.

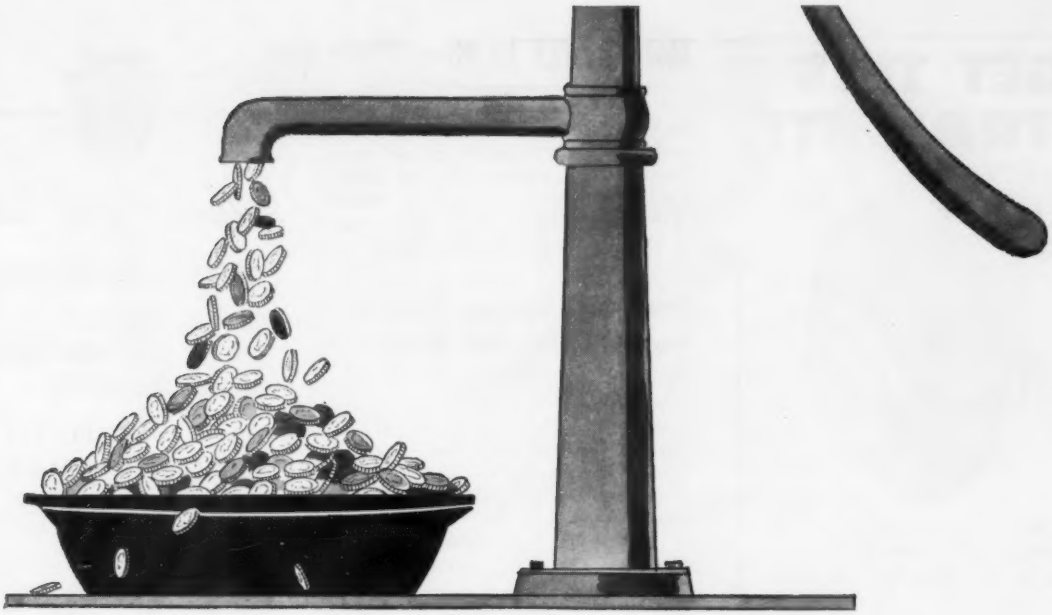
• PENNSYLVANIA STATE UNIVERSITY has received approval from AEC to build a "swimming pool" type reactor for nuclear research and training of students. The Commission will allocate fissionable material to Penn State, but the school will have to bear the $1¼-million cost of construction. The reactor will operate at the 100-kw power level, will use enriched uranium fuel and ordinary water for coolant-moderator.

• ON THE MILITARY SIDE of the atomic picture we have the recent launching of *Nautilus*, the reactor-powered submarine. This $55-million craft will use enriched uranium as fuel, ordinary water

This message from

Power

appeared recently in Business Week to remind management men throughout industry of the vast scope and key importance of power and of the men who direct the power services



How many times can you multiply 29,000 dollars?

A little over a year ago, POWER published a story about a tired, old, worn-out pump, its usefulness very nearly destroyed by erosion of its innards.

But an ingenious new process – coating metal with neoprene – saved it, restored the old pump's efficiency and put it back on the job. The coating cost $1,000. A new pump would have cost $30,000. So the owner saved $29,000.

The firm that did that job got a lot of mail (and a lot of business) after that story ran in POWER. Inquiries came from all over the world. They're *still* coming.

This, however, is not the point.

What we'd like to remind you of is: Showing power engineers how to save $29,000 by reconditioning a pump is but one small item in one issue of a great industrial magazine. How many times would you have to multiply 29,000, to measure the bedrock, money-saving contribution made to industry by business publications?

Chances are the man in charge of your power services reads POWER.

He may have ideas now on how modernizing or reconditioning in your power plant can cut costs and promote efficiency. Have you talked this over with him lately?

One of America's primary industrial media and a member of the Audit Bureau of Circulations

McGRAW-HILL . . . ABP

"GET THIS STRAIGHT!"

All I want is an opportunity to prove that Enos and Enoco coals can do the job better.

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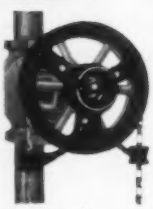
Babbitt Adjustable SPROCKET RIM with Chain Guide

Avoid accidents and costly claims against your company! Operate overhead valves direct from the floor — without ladder climbing, balancing on boilers, standing on workbenches and machines or other risky perches.



Check these outstanding advantages of Babbitt Adjustable Sprocket Rim with Chain Guide:

- Cuts fuel & steam waste
- Fits all valve wheels
- Prevents accidents

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems. Only four simple parts, quickly-assembled, quickly installed.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

2 BABBITT SQUARE, NEW BEDFORD, MASS.

More POWER NEWS

Begins on page 150

as moderator-coolant. The Navy's second atomic sub, *Sea Wolf*, is now under construction at Groton. The world race for both industrial and military control of the atom seems to be showing no signs of slowing down in the near future.

New Lehigh Brochure Stresses Problem of Engineer Shortage

► LEHIGH UNIVERSITY recently published a brochure stressing the current problem of engineer shortages. The illustrated booklet tells just what the present shortage is, how it came about and what some possible solutions might be.

Top industrial executives have been pointing out, for the past several years, the necessity for corporations to support actively educational institutions. Lehigh's study of the problem shows just how such support may be provided. In addition, the university has undertaken a program of its own. To date 30 firms have provided over $300,000 in scholarships.

An electrical engineering laboratory, only one of its kind existing in an educational institution, has been donated to Carnegie Institute of Technology by Westinghouse Electric Corp. Valued at $100,000, new installation is for purpose of stimulating student interest in power engineering, an interest that has been overshadowed by the swift advances in the communications field.

This lab will serve educational and research programs dealing with detailed and advanced study of electrical power systems. It is the largest single facility ever donated to an educational institution by an industry.

Hitachi, Ltd of Tokyo recently completed two 45,000-hp Kaplan hydro turbines for Honna power station, now under construction. These units, the largest in Japan, will operate under 118-ft head at 167 rpm. Hitachi will also have a 20,000-hp Kaplan unit to operate under 180-ft head, the highest in Japan and one of the highest in the world.

United States Court of Appeals has upheld a patent covering corrosion-control methods now used to protect municipal and industrial water systems of some 600 cities and 1300 factories and plants. In a precedent-making case, the Fourth Circuit Court of Appeals handed down a mandate protecting a patent owned by Hall Laboratories, Inc of Pittsburgh.

The Hall suit charged Springs Cotton Mills, Inc of South Carolina with illegal use of a patented method for protecting water mains, piping and equipment against corrosion. The patent involves the use of very small amounts of metaphosphate.

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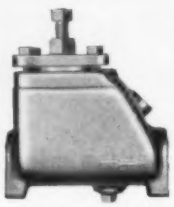
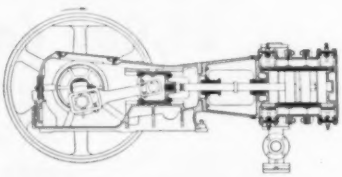


AIRCHEK VALVE

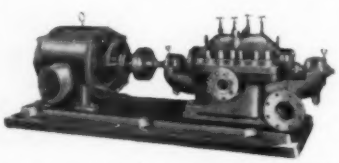
Automatically prevents reverse flow through Compressor and also dampens pipe line pulsations.

This Check Valve should be on EVERY reciprocating Compressor. Bulletin 509-12



OILFREAIR & OILFREGAS Compressors Class ATL with steel-backed carbon cylinder-liners. Guaranteed to compress free of any trace of oil or oily vapors.

Bulletin 600-12



PENNSYLVANIA 4-Stage THRUSTFRE Centrifugal Pump for Boiler Feeding, General Power Plant and Industrial Use.

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It's still coal that puts flavor in the roast

Like millions of other farm women, Mrs. Curtis now enjoys the convenience of a gas or electric range, along with refrigeration, a food freezer, running water, a power washer and all the other modern, labor-saving appliances.

But it's still coal that puts the flavor in the roast – bituminous coal, used efficiently in a distant power plant. America's public utilities are burning more than twice as much coal today as they did twenty years ago. Except in a few areas where other fuels are abnormally low in price, coal is the cheapest source of energy – cheaper even than water power. The TVA is now supplementing its great hydroelectric installations with coal-burning steam plants.

Another reason large fuel buyers favor coal is the assurance of continued supply. Even at our ever-mounting rate of consumption, known reserves are ample for a future measured in thousands of years. These reserves are well distributed over the United States and great coal hauling railroads like the Chesapeake and Ohio are equipped to handle enormous quantities of coal promptly and efficiently.

Chesapeake and Ohio Railway

COAL...FUEL OF THE FUTURE

Bring your fuel problems to C & O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

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Coagulation of wide PH range. Efficient operation regardless of rapid variations of raw sewage. Effective for conditioning the sludge prior to vacuum filtration or drying on sand beds.

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SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

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More POWER NEWS

Begins on page 150

Sweden is now building her largest power station on the Ume River some 200 miles south of the Arctic Circle. The new Stornorrforsen plant will have a capacity of 380,000 kw in three units and will generate 2.2-billion kw-hr annually. The first two units are scheduled to go on the line in 1959, the third in 1960.

Russia's Mingechaur power plant, one of the major hydro projects of the USSR's fifth 5-year plan, has gone into operation. Largest in Transcaucasia, the Mingechaur station will provide a reliable power source for the important Baku oil industry. The dam was erected by the hydraulic-fill method and is reportedly the highest in Europe. The reservoir it forms will feed four main canals irrigating some 2½-million acres.

Dept of Engineering Mechanics at University of Detroit has installed equipment that may be used for research involving hydraulic pressures up to 25,000 psi. This equipment can also be used for the calibration of pressure gauges of all sizes and capacities. It is available to industry for research in this pressure range.

New color movie offered by Aluminum Company of America demonstrates and explains latest developments in light-metal brazing techniques. *New Horizons in Aluminum Brazing*, a 22-minute 16-mm sound film, shows what can be done in brazing and how to do it. Requests for prints should be made on business letterhead to Motion Picture Section, 854 Alcoa Bldg, Pittsburgh 19, Pa.

Air Reduction Co has released a new 16-mm color-sound motion picture entitled *Whatever We Do*. This is a basic documentary film dealing with atmospheric gases and their application in industry. Non-technical in nature, it presents in easy-to-understand fashion the manufacturing process and distribution system involved in the marketing of atmospheric gases. The film is available on request to Air Reduction Sales Co, 60 E 42d St, New York 17, N. Y.

Administrative Committee on Standards of ASTM recently approved many new specifications and significant revisions. Copies of all new ASTM specifications are available, for a nominal fee, from ASTM headquarters, 1916 Race St, Phila. 3, Pa.

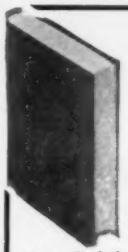
Arthur D Little, Inc is making an area development survey of Venezuela for the International Power Co of Montreal. This project involves investigation of industrial opportunities in the Maracaibo and Barquisimeto regions to determine new products that might be manufactured there.

Universal Machine Co of Ambridge, Pa. announces a new consultation service for on-the-line repair of high-pressure valves. Instituted as an adjunct to the concern's regular valve reconditioning activities, the new service is designed to cut outage time.

THEORY and DESIGN of STEAM and GAS TURBINES

Just Published!

Complete, fundamental treatment presents modern theory of turbine flow passage design in a manner understandable to engineers regardless of background in aero- or gas dynamics. Theories are examined, explained, and applied. Covers the various types of turbines and their power cycles. Gives basic thermo- and gas dynamics involved. Details factors affecting design of nozzles, turbine flow passages, other mechanical aspects. Explains control and performance, compressors, combustion, etc. **By John F. Lee, Assoc. Prof. of Mech. Eng., N. C. State Coll. 502 pp., 322 illus., $9.00**



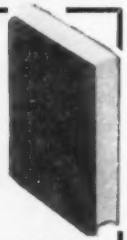
STEAM PLANT OPERATION

Offers much information to help you pass power plant engineer license examinations. Explains advanced rules of stationary engineering — outlines tested methods of operating power plant equipment — and points out the responsibilities of the operating engineer relative to safe practices and efficient operation. Includes valuable lists of questions typical of those asked in license examinations. **By Everett B. Woodruff and H. B. Lammers. Second Edition, 543 pp., 264 illus., $8.00**

INSTRUMENT and CONTROL MANUAL for Operating Engineers

Finger-tip information on the construction and operation of all types of indicators, controllers, and control systems. Designed for the man in the plant . . . describes the most modern instruments for measuring and controlling liquid levels, pressure, temperature, speed, and humidity. Provides you with concise explanations of various systems, and enables you to maintain your control equipment with minimum loss in time and labor. **By Eugene W. F. Feller, Operating Engr. 426 pp., 484 illus., $7.00**

PLANT ENGINEERING HANDBOOK



Now you can find in a single handbook the facts that literally do show how to run a plant today—any industrial plant—efficiently and economically. Answers questions in the economic, mechanical, and power operation of a plant. Covers principles and methods followed by leading manufacturing enterprises. **William Staniar, Editor-in-Chief. 2007 pp. 1406 illus., 544 tables, $15.00**

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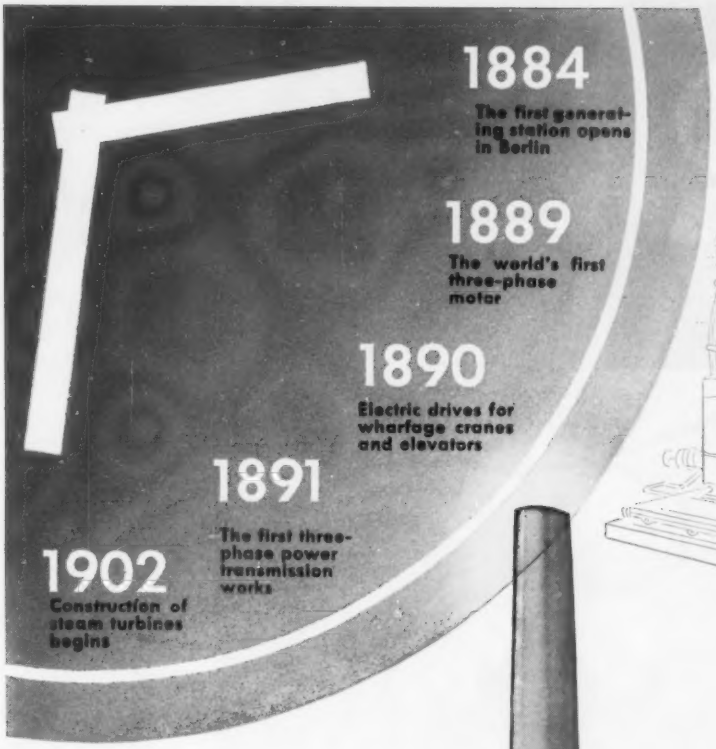

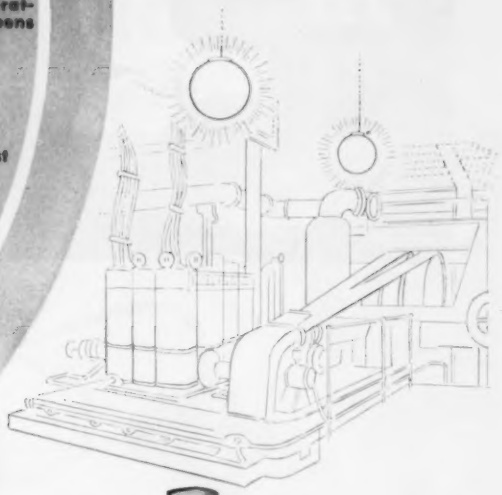

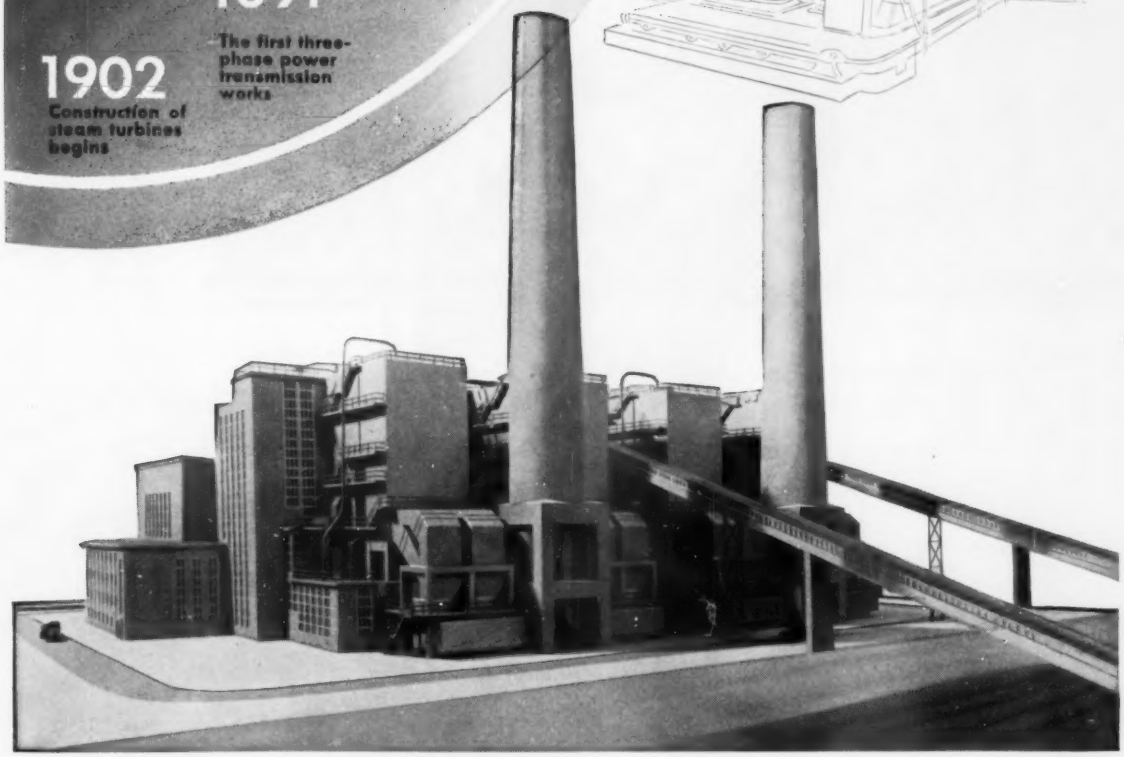

The first hours of Electrical Engineering

The AEG has been engaged in the design and erection of power stations ever since 1883. Millions of kilowatt have been generated in AEG steam and water power plants in every corner of the globe

AEG means Electricity

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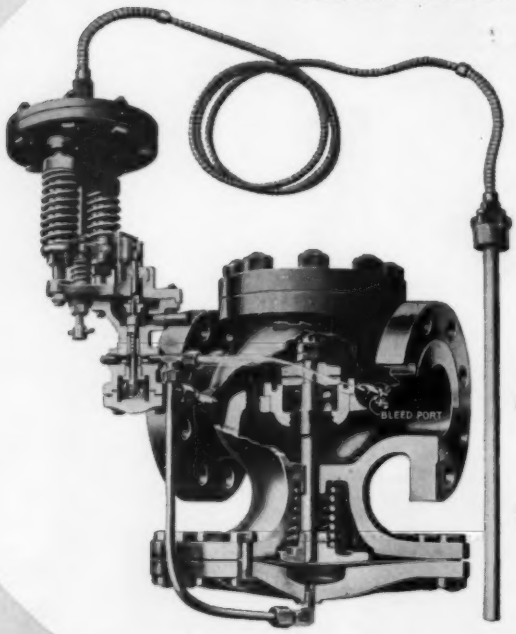
ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

Berlin (Brit. Sector) Export Department Frankfurt (Main)

3 Reasons for Accurate Regulation

SPENCE TYPE ET150
TEMPERATURE REGULATOR



PACKLESS CONSTRUCTION

LARGE BALANCED METAL DIAPHRAGM

SENSITIVE PILOT

Spence

Packless construction eliminates the need for closely fitted parts that may stick or bind due to dirt or uneven expansion of the parts.

In Spence Temperature Regulators, the Main Valve is actuated by a large balanced metal diaphragm which responds to the slightest changes in temperature.

Sensitive Pilots are designed to limit heater pressure to an adjustable maximum. As the temperature at the thermostat drops a few degrees there is a corresponding increase in steam pressure up to the limit for which the Pilot is set.

With regulators that respond only to temperature, an increase in load is accompanied by a momentary decrease in steam pressure caused by faster condensation in the heating element. There is a time lag until the thermostat senses the temperature drop and opens the valve wider. Spence Temperature Regulators act like pilot operated pressure regulators when this occurs. They respond instantly to maintain the steam pressure until the thermostat has a chance to further increase it as needed for the heavier load.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

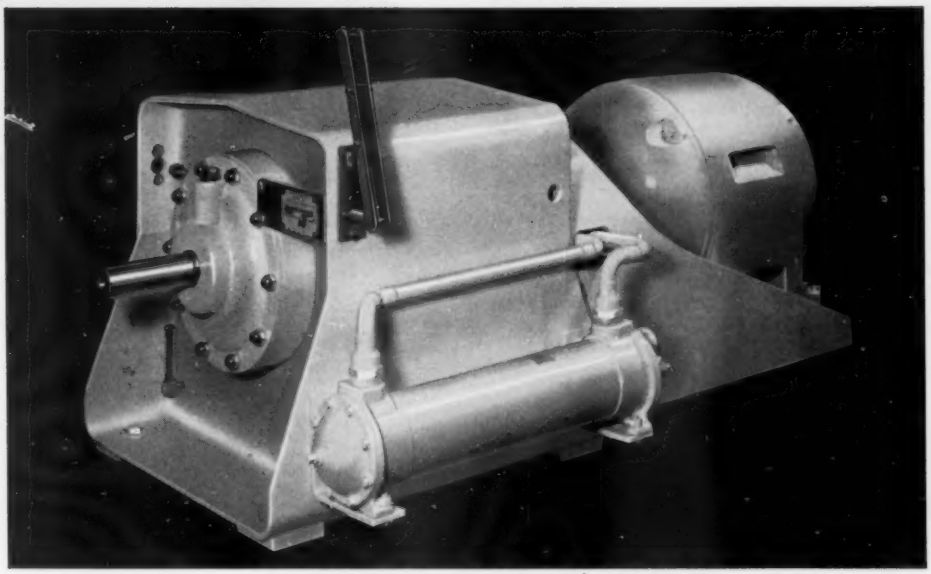
8E120

SPENCE ENGINEERING COMPANY, INC., Walden, New York

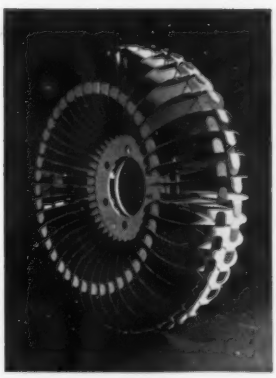
ANNOUNCING THE NEW AMERICAN BLOWER

Gýrol FLUID DRIVE

TYPE VS CLASS 2



American Blower Type VS Class 2 Gýrol Fluid Drive



A phantom view of the driving and driven members, which provide smooth, reversible power transmission.

- **Can be reversed while in motion at any variable operating speed by merely reversing direction of rotation of motor**
- **Permits adjustable speed control over a wide range**
- **Built in several standard arrangements**

HERE IT IS! A brand-new fluid drive that will help you solve many tough industrial-drive problems. It's the American Blower Type VS Class 2 Gýrol Fluid Drive. A compact, self-contained, adjustable speed unit.

The result of years of development and research, this adjustable-speed fluid coupling is crammed with features. It has unlimited application possibilities, with its wide-range, stepless speed, reversible control. Even on constant-torque loads, a 4-to-1 speed range is obtainable!

It permits driving motors to reach full-load speed before engaging the load. In many cases simple across-the-line starting may be used. Adjustable speed may be obtained by either automatic or manual adjustment of the speed-control lever.

The new Type VS Class 2 Gýrol Fluid Drive is available in six sizes . . . 7½ through 800 h.p., at normal motor speeds up to 1800 r.p.m. Built in five standard arrangements, it can be used on a wide variety of industrial applications.

For complete information about the Gýrol Fluid Drive line, give your nearest American Blower Branch Office a call, or write us direct for free literature.

For smaller applications the Type TM Constant Speed Gýrol Fluid Drive is available in ratings from 1 to 20 h.p.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

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Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

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CHASE® COPPER BUS CONDUCTORS WITH ANY OTHERS . . . . . for capacity
. . . for copper savings
. . . for efficiency

Chase ventilated square tube buses can cut your copper requirements up to 36% as compared with flat rectangular bars.

The current ratings of some of the Chase ventilated square tube buses are given in the table to the right. Bear in mind that the square tube bus is a one-piece bus and is not a composite bus consisting of two or more parts.

Send for Chase Copper Bus Conductor booklet giving information on Chase ventilated square tube, flat rectangular and round copper tube buses.

CURRENT CARRYING CAPACITY OF ONE-PIECE BUS

	Square Inches	Current Rating at 40° C. Rise
7 x 7 x 3/8 Ventilated	9.06	7760
8 x 8 x 5/16 Ventilated	8.80	8400
9 x 9 x 1/4 Ventilated	7.93	8560

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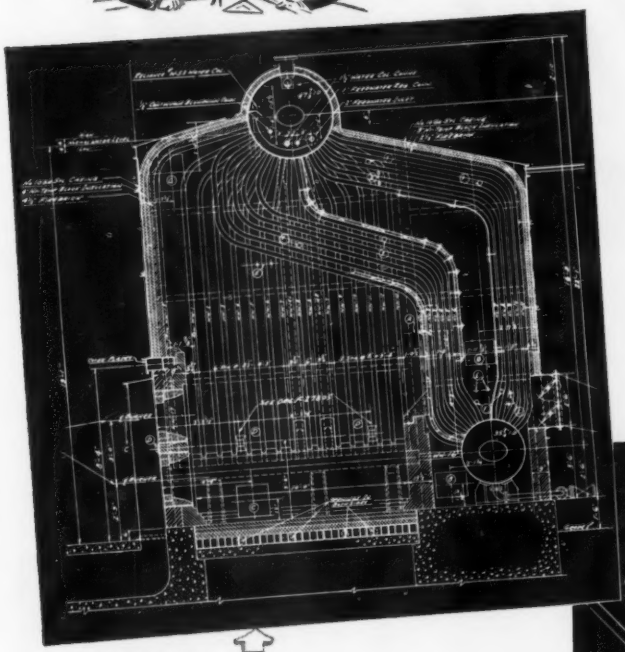
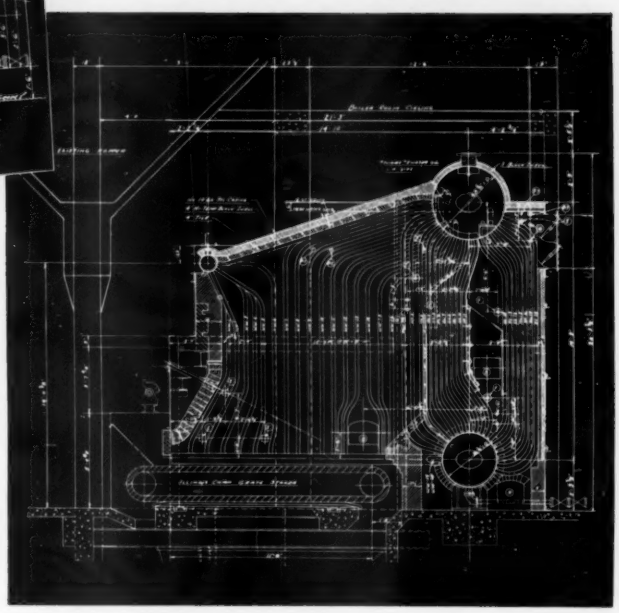
Chicago	Houston	Newark	Rochester †	(† sales
Cincinnati	Indianapolis	New Orleans	St. Louis	office only)

Industry Approved

Two-Drum STEAM GENERATORS by Vogt



CLASS VF
A 22,000 pounds steam per hour unit installed at Indiana Farm Bureau Refinery, Mt. Vernon, Ind.



CLASS VS
The Seelbach Hotel, Louisville, Ky. is served by this 30,000 pounds steam per hour boiler.

A wide variety of industrial plants and other users of steam for power, processing, or heating have found these efficient Vogt Two-Drum Type Boilers to be the answer to their diverse steam generating requirements.

Class VF units provide maximum capacity in limited floor space and head room, while Class VS is best adapted to installations not having such restrictions. Each has a large furnace volume and a high ratio of radiant heating surface. The furnace design assures proper combustion of fuels fired in suspension or with various type of stokers.

A bulletin with general information and showing typical installations is available on request.

Typical Users...

FOOD PROCESSING PLANTS

DISTILLERIES • HOTELS

HOSPITALS • CHEMICAL PLANTS

PETROLEUM REFINERIES

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

Packard chose CLARAGE

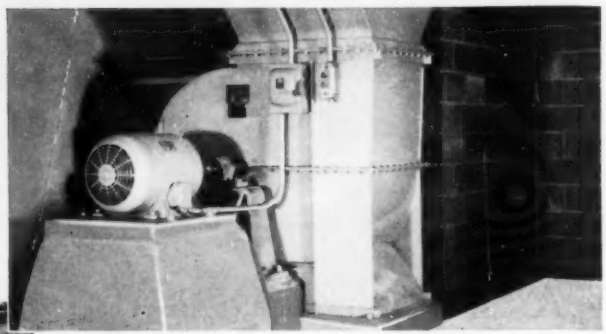
This is the new Packard Motor Car Company power plant in Utica, Michigan—expertly designed to generate steam at lowest cost.

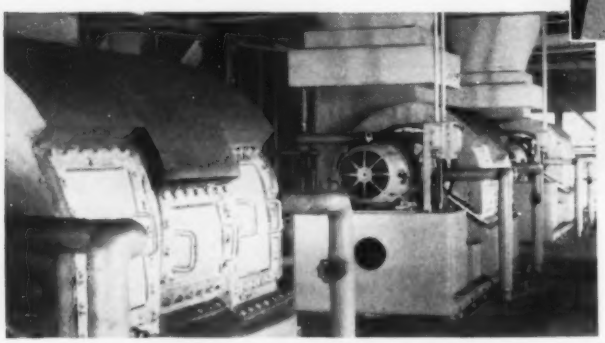
Packard installed Clarage heavy-duty draft fans — *a very wise decision!*

. . . for as the years go by, Clarage fans will pay off time and time again — meeting varying load demands *exactly*, operating *more economically*, giving round-the-clock service with an *extraordinary freedom* from maintenance and repairs.

3 FORCED DRAFT FANS

OPERATING DATA: — Each forced draft fan (equipped with Clarage Vortex capacity control) has a certified rating of 11,000 c.f.m. of standard air at 3" static pressure when operating at 1160 r.p.m.





3 INDUCED DRAFT FANS

OPERATING DATA: — Each induced draft fan (equipped with Clarage water-cooled bearings) has a certified rating of 18,000 c.f.m. of flue gases at a temperature of 560° F. when operating at 1160 r.p.m.

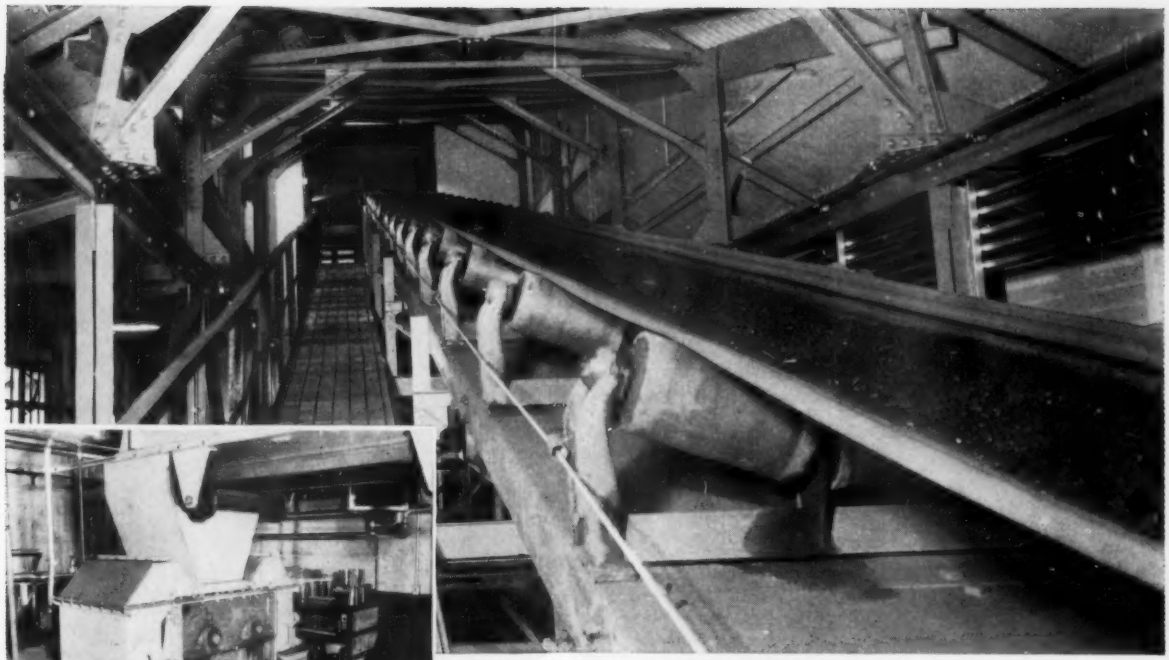
Want to know the secret of the superior performance you get from Clarage fans? Then write for the Clarage Service Manual — which tells all! 78 pages of valuable information on your BEST BUY in air handling and conditioning equipment. Clarage Fan Company, Kalamazoo, Michigan.

You can Rely on...

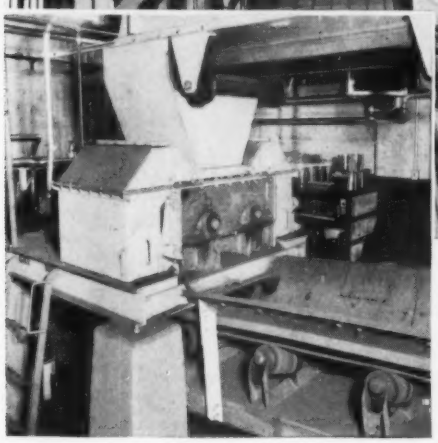
CLARAGE

Headquarters for Air Handling and Conditioning Equipment

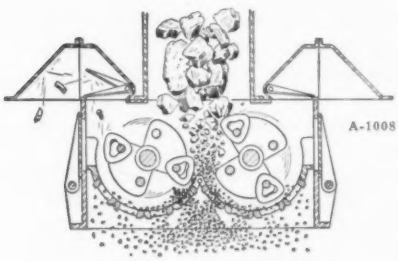
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



Two 17-inch loop boot double leg REDLER elevators, operating in very limited space, feed crushed coal to the 30-inch slope belt shown above. This belt, handling 200 tons per hour, feeds a cross belt conveyor that delivers coal to twin shuttles.



Above: 18" x 24" double rotor Knittel crusher. Cross section shown below demonstrates how wet coal delivered from track hoppers is crushed without clogging. Steel fingers lift independently to take out uncrushable material without stopping crusher. Costly shutdowns for cleaning are unnecessary and capacity is maintained.



"Tailor-Made" Coal Handling System Moves 200 Tons Per Hour in Limited Space

"Fit the system to the job and meet limitations of existing buildings and structural plant conditions", were the big problems S-A engineers faced when they designed a system for handling coal for this power plant. Fast, low-cost crushing and conveying were additional requirements.

High capacity crushing of coal is done by two 18" x 24" double rotor Knittel crushers. Coal falls to two short belt conveyors feeding two 17-inch loop boot double leg REDLER elevators. These two REDLERS operate in a very limited space yet handle 100 tons per hour, each. The coal is lifted 76 feet and fed to slope belt conveyor shown in photo. The slope belt runs through a gallery and discharges to a 30-inch reversible belt which can feed either one of two 30-inch shuttle belts. The shuttle belts are 81 feet long and self propelled.

When you consider any changes or additions to your present conveying system, ask to have an S-A engineer go over the problem. He can find the low-cost solution for you to meet demands of limited space or *any other need*. He works with a complete line of bulk materials handling equipment — is backed by the experience and resources of the full S-A engineering organization.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

Engineering Division

Specialists in the design and manufacture of all types of bulk materials conveying systems.

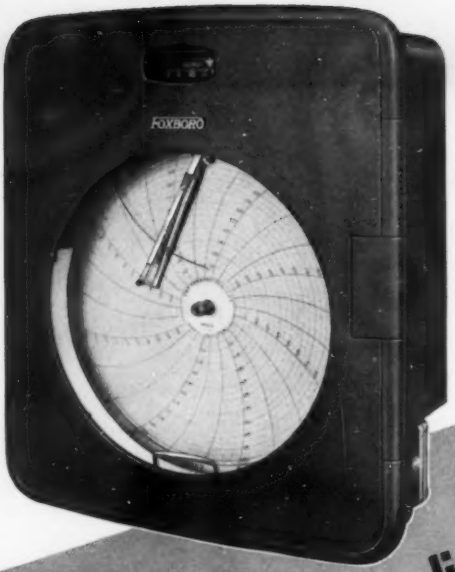
Standard Products Division

A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

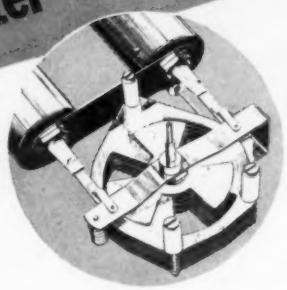
Sealmaster Division

A complete line of industrial ball bearing units available in both standard and special housings.

An unbeatable pyrometer for any range between -300° and +2800°F.



DYNALOG* ... the electronic potentiometer that has no slidewire!



This simple variable capacitor is important to potentiometer users because it eliminates the conventional, troublesome slidewire altogether; and it gives Dynalog Instruments the continuous *stepless* balancing which assures higher accuracy, closer control.

TOPS in simplicity . . . unequalled in its combination of accuracy, sensitivity, and speed of response . . . the Dynalog Potentiometer with standard thermocouples gives you unerring temperature measurement for any range up to 2800°F. Featuring *sustained* accuracy of ¼ of 1% of scale, it's an instrument of laboratory precision built to withstand the severest industrial conditions.

Unprecedented freedom from maintenance is the direct result of unique Dynalog design. There's no slidewire, no battery to standardize. There are no gears, belts, or high speed reversing motors. There's nothing to wear and cause dead space.

Single pen recording models provide full scale pen travel in 3 seconds standard, or as fast as 1 second without extra cost. The Multi-Record Dynalog provides color-coded records of up to 6 points at 6 second intervals. Both types give the convenience and low cost of circular charts.

Dynalog Potentiometers are also used for the measurement of pH, oxidation-reduction potential, and for other applications in which the process variable can be converted to a dc millivolt signal. They are available for pneumatic or electric control.

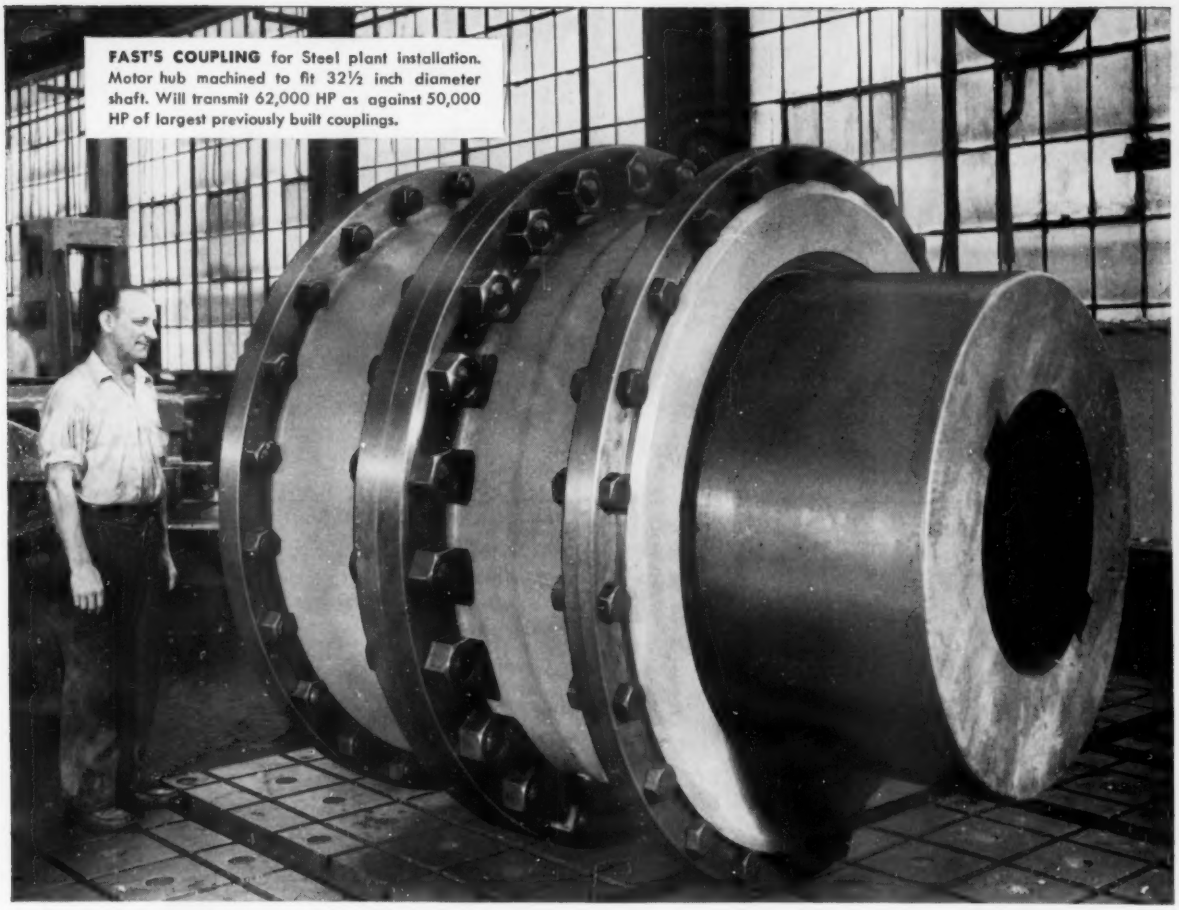
Write for your copy of Bulletin 427-1 which gives the whole story.

*Reg. U.S. Pat. Off.

THE FOXBORO COMPANY, 683 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO REG U S PAT OFF **POTENTIOMETERS**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



FAST'S COUPLING for Steel plant installation. Motor hub machined to fit 32½ inch diameter shaft. Will transmit 62,000 HP as against 50,000 HP of largest previously built couplings.

WORLD'S LARGEST INDUSTRIAL GEAR-TYPE COUPLING

To make a coupling that will transmit 62,000 HP and compensate for errors in alignment . . . that's more than a man-sized job.

But Koppers took on the project and this Fast's Self-Aligning Coupling is the result.

After six months of machining and assembly, this huge, *all metal* coupling is on its way to installation in a Milano, Italy, steel mill where it will carry power to a Mesta, 110-inch, four-high reversing plate mill.

It will transmit power from an electric motor to the equipment, and, at the same time, compensate for shaft misalignment and lateral float, give maximum power transmission efficiency, eliminate breakdowns and costly down-time.

WHAT'S YOUR COUPLING PROBLEM?

This mammoth Fast's Coupling is just one example of the outstanding jobs which Koppers is equipped to handle. 35 years of manufacturing "know-how" go into the production of *all* Fast's Couplings, large and small alike. Engineering specialists, experienced in designing Fast's Couplings for special applications, are well equipped to solve your coupling problems.

Remember, there's a Fast's Coupling for every power transmission application. Next time you have a coupling problem, call on Koppers . . . always ready to serve you. No obligation, of course. Also, for full details on Fast's Couplings for industry, mail this coupon.

THE ORIGINAL **Fast's Couplings**

KOPPERS®

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

Engineered Products Sold with *Service*

KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* **223 Scott St., Baltimore 3, Md.**

Gentlemen: Send me FREE, Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

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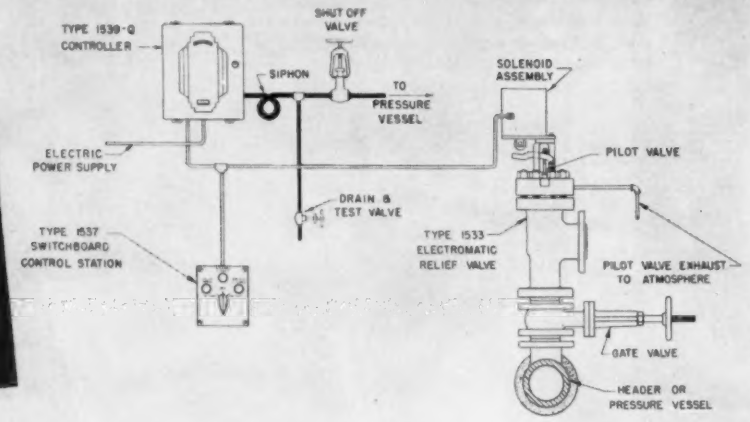
THIS IS THE CONSOLIDATED ELECTROMATIC RELIEF VALVE SYSTEM



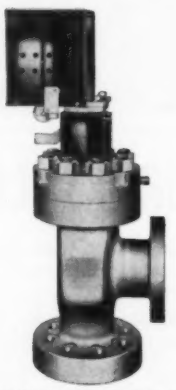
THIS IS WHAT IT GIVES YOU

1. More accurately balanced boiler operation at peak loads.
2. More uniform line pressure.
3. Power conservation.
4. Less maintenance of spring-loaded safety valves.
5. Greater protection against overheating your superheater.
6. Increased efficiency for your steam generating plant.

Automatic, electrically actuated, the Consolidated Electromatic Relief Valve can be set for a differential of 1% or less between opening and closing pressure; relieves pressure precisely within close limits. The valve is operated by a solenoid actuated by a pressure-sensitive element or switch. For automatic or manual service or to cut the valve out of service, just set the switch. Cyclic action is practically instantaneous. Valve operation is not affected by high superheat temperatures or other variables. Manual operation *at any pressure* assures positive circulation through the superheater and greater steam flows during start-up periods than the vent valves normally provide. Danger of burning superheater tubes is minimized under all conditions of service.

You can also use the Consolidated Electromatic as a superheater surge vent or to purge a superheater or header — reduce the possibility of damage to the seats of regular valves and turbine equipment.

Greater efficiency and economy is a "must" in the steam generating plant. That is why the Consolidated Electromatic Relief Valve is important to you. Get complete construction, installation and operating details. Write today for Bulletin 720.



CONSOLIDATED ELECTROMATIC RELIEF VALVE

Sizes:
2½", 4", 10", 14"
Pressures:
Up to 2500 p.s.i.
Temperatures:
Up to 1100° F.
Standard Connections:
A.S.A. flanged and welded.

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

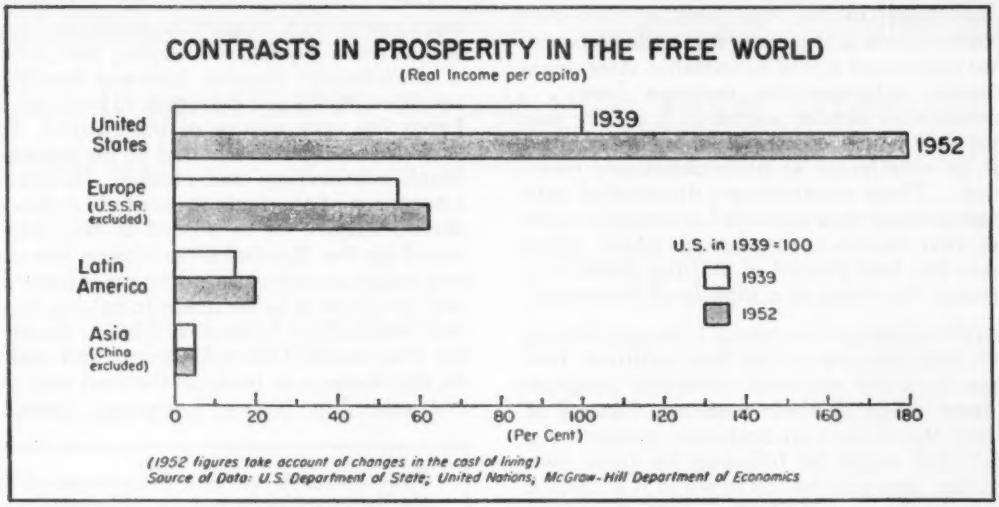
Contrasts in Prosperity Endanger the Free World

The chart in the middle of this page summarizes a situation of profound importance to every American. It shows that:

1. On the average, Americans are vastly better off economically than most other people in the free world, and
2. In recent years the gap in income between the average American and the average European, Latin American or Asian has greatly widened.

A Mounting Contrast

Even greater is the contrast between the real incomes of Asians and Americans. Today most Asians are no better off economically than they were back in 1939. On the other hand, the real income of the average American has almost doubled. As a result, the real income of the average Asian—always small by our standards—is now only a tiny fraction of that of Americans.



The chart shows that, at the outbreak of World War II, the real income (that is, actual purchasing power of income) of the average American was substantially higher than the average European's and much higher than the average Latin American's or Asian's. Since then, the European and Latin American have become better off. But the improvement in the economic lot of the average American has been so great that the others have been left far, far behind.

It must be remembered that the figures used to construct the chart are of varying quality. The fact is that few of the poorer countries have reliable statistics. However, it is generally agreed among competent observers, that the figures here presented offer a correct impression of the wide disparity in the average of real incomes between various parts of the free world. The figures, of course, have nothing decisive to say about spiritual and cultural values. In these, coun-

tries with relatively little material prosperity may be rich.

It is possible to draw a variety of morals from the story of lagging growth of income in other parts of the world. For one thing, it reflects the dynamic force of private enterprise. Private enterprise is characteristic of our economy far more than it is of most of the other free economies. The chart also reflects the fact that we are bountifully blessed with the natural resources essential to a high level of real income. Moreover, we did not suffer from the devastation and waste of two world wars as did many of the other free nations.

Narrowing the Gap

But perhaps the most important message which the chart conveys is one of warning. It warns that something must be done to narrow the gap in prosperity between America and other parts of the free world, if that world is to be united successfully in the struggle against totalitarian Communism. Writing in the HARVARD BUSINESS REVIEW, Kenneth E. Boulding recently put it this way:

> *"The crux of the problem is how to raise the three-quarters of the world that live on a low level to the high level of the other quarter, for it is precisely this wide disparity that makes our world so unstable. American-Russian relations, for instance [are] . . . complicated almost unbearably by the fact that each power is competing for the support of the vast fringe of underdeveloped countries . . . These countries are dissatisfied with their present state and are hovering between the two cultures, wondering which offers them the best chance of shifting from their present low-level to a high-level economy."*

Very real danger threatens from any feeling which may develop in the less fortunate free nations that our enviable economic progress has been made at their expense. Instead of viewing the American economic system as a model that might be followed by their own countries, they may be led to see in it a menace to their well-being. If Communist propaganda can persuade these people that their alliance with the free world will only result in their dropping farther and farther behind an increasingly prosperous United States, they will be driven to the side of totalitarianism.

Test of Effective Leadership

How can these free nations on the lower half of the income ladder be helped to alleviate the conditions that keep them there? Surely this question poses a whole series of complicated problems. Yet, if we do not exercise some effective leadership toward their solution, we can be sure that Russia will take advantage of the situation. In these circumstances, it is essential to both the stability and security of the free world that we help our less prosperous neighbors make satisfactory headway.

This does *not* mean that the United States should sacrifice its own economic progress in favor of some sort of global leveling scheme. On the contrary, a continually expanding and stronger economy is essential if we are to provide any real aid to our friends. Also, it goes without saying that our friends must be disposed to do all they can to improve their own economic position, if our cooperation to that end is to be effective.

Great Skill Required

Our part in a program to achieve this goal calls for a high degree of skill and statecraft. It involves international trade policy, which, in itself, presents a perplexing range of problems. It involves also programs of foreign technical and economic assistance. And expanded foreign investment must play a key role in a balanced program to strengthen the economies of the free world for our common good.

The Commission on Foreign Economic Policy, headed by Clarence Randall, has recently submitted a report, embodying the results of a monumental inquiry into our foreign economic relations and measures to improve them. From the very nature of the subject, discussion of the report is bound to be attended by much controversy and conflict. However, an awareness of the facts presented by this chart should inspire us to accord to the problems posed by the Randall Commission the careful and sober consideration they must have if any real progress is to be made in raising the general standards of human well-being throughout the free world. Our willingness and ability to do this have now become the real test of our statesmanship, both at home and abroad.

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Donald C. McGraw

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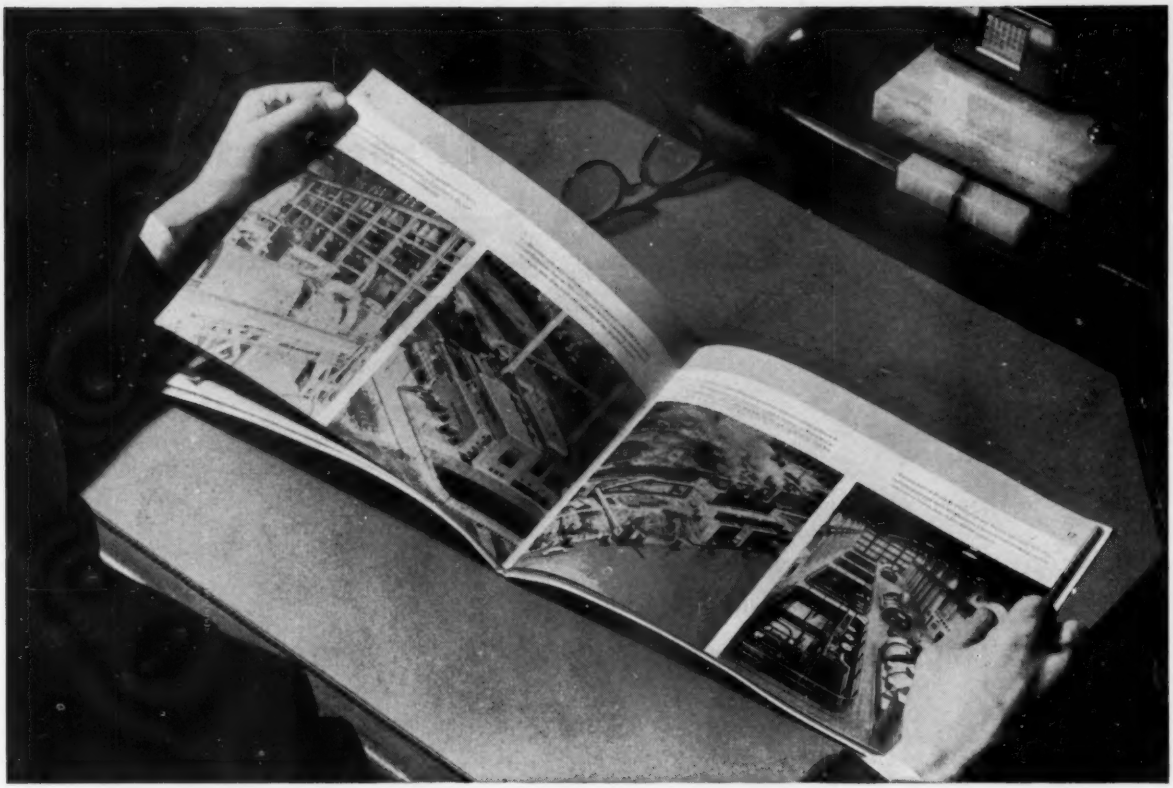

Let this BOOK show you how Dravo's Construction Department can work for you

Whether it's the installation of a pump or the furnishing and installing of a water and waste treatment plant . . . the fabrication and erection of piping . . . the construction of oil or gas pumping stations or the construction of a power plant . . . it's a job Dravo's Construction Department can do for you. Dravo's range of engineering construction activities is described in this new 45-page book, filled with photographs of many typical examples of Dravo-built installations throughout the United States.

The book also describes how Dravo accepts the responsibility for construction on a single-contract or "turn-key" basis. This includes the planning of an entire project from the blue-print stage, purchasing as designated, handling all phases of construction and turning over to you the completed job ready for operation.

Dravo's Construction Department is equipped with trained personnel—backed by more than 60 years engineering experience—and capable of performing a wide variety of construction assignments.

Find out how you can profit through Dravo's single-contract service. Let us send you a copy of "Dravo—Engineering Constructors." Ask for Bulletin No. 1200.

DRAVO
CORPORATION
PITTSBURGH, PENNA.
Sales Representatives in Principal Cities

Dravo Corporation, Construction Department
Fifth and Liberty Avenues, Pittsburgh 22, Penna.

Please send me a free copy of Bulletin No. 1200

Name_____

Title_____

Company_____

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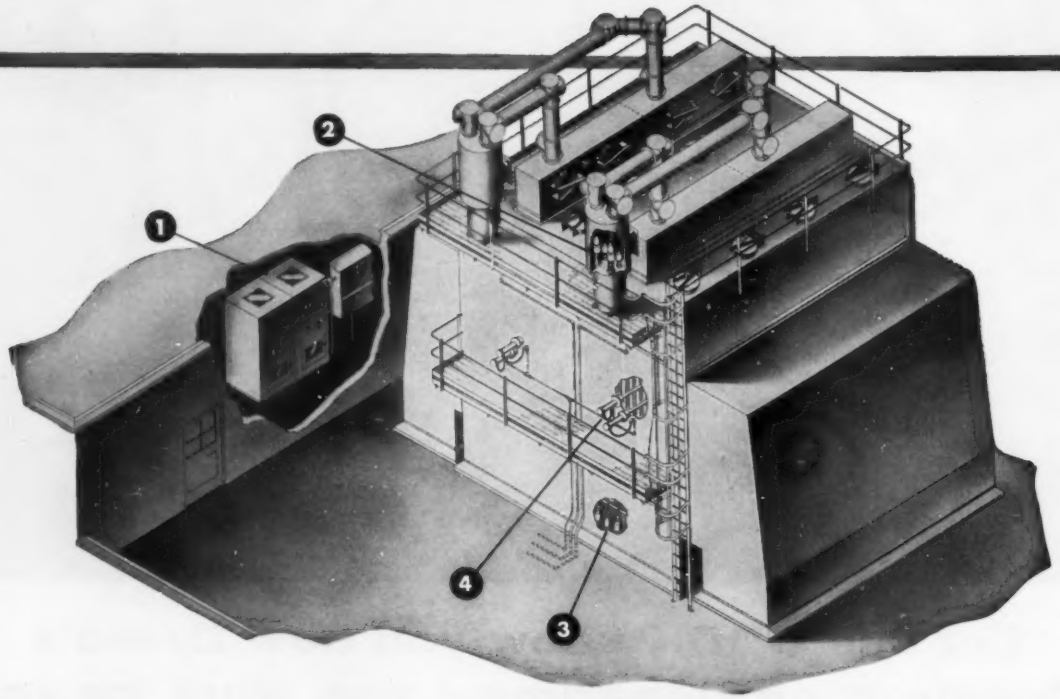
What's New in Electrical Precipitators?



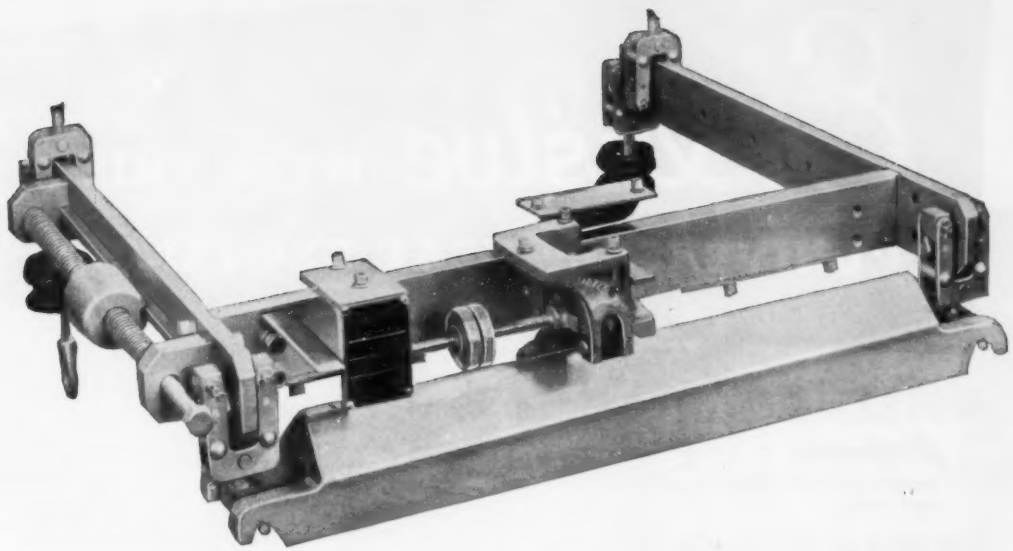
FEATURES:	RESULTS:
1. Remote Control—Entire installation is operated by switchboard control from any convenient location.	**1.** Central control room operator can see all meters and operate all controls that determine optimum performance.
2. Low-cost Energization—Weatherproof high voltage transformer and electronic tube rectification equipment allow location flexibility and minimum power consumption.	**2.** Space conservation, short high voltage connection between rectifiers and precipitators insure compact, economical installation.
3. Unique Electrode Design—Plumb-bob discharge electrodes, individually weighted to remain taut, are uniformly positioned by a lower framework.	**3.** Discharge wires are kept perfectly aligned at all times for maximum overall precipitator performance.
4. Electronically Controlled Rapping—New magnetic impulse rappers are designed for continuous, sequential, smoothly regulated electrode rapping.	**4.** Eliminates stack puffs and produces increased overall efficiency.

Ask your Research Corporation representative to bring you up to date on the details of these and many other improvements that you will find in the modern Cottrell Electrical Precipitator.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
Bound Brook, N. J. • Grant Building, Pittsburgh 19, Pa.
122 South Michigan Avenue, Chicago 3, Ill.

RC143



Attention to Detail is the Reason Why

whatever you buy from Stock Equipment Company is of the highest quality. Take the weigh lever system illustrated above, for example. Top performance is assured because careful attention to design detail utilizes a non-welded steel assembly with steel loops. Hardened steel pivots and bearings in this light-weight unit mean low inertia and faster action with resultant greater accuracy.

No matter if it's the design of a pivot in a weigh lever system, the layout of the overall job of delivering and weighing coal between bunker and pulverizer, or the fit of a dust-tight slip joint connection (as illustrated to the left), Stock Equipment Company takes time to make sure that it is right. This attention to detail means a completely satisfactory and overall economical job for its customers.

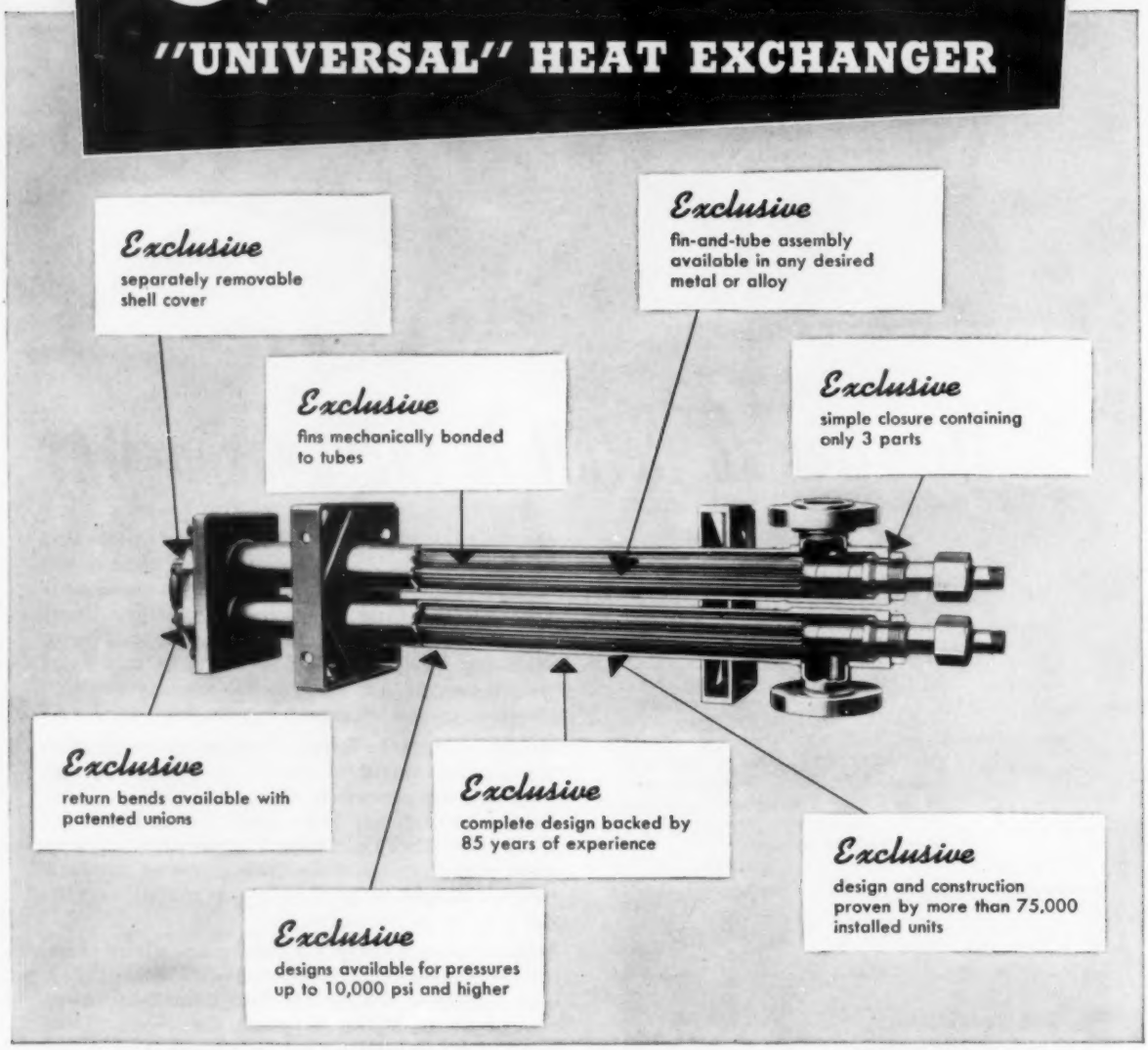
Pride of workmanship is a common attribute of all S-E-Co. employees and is reflected in all items of their manufacture, which include the S-E-Co. Coal Valve, Soot or Sifting Valve, Automatic Coal Scale, CONICAL Non-Segregating Coal Distributor, Automatic-Under-Bunker Conveyor, and Paddle Type Coal Alarm. Next time you need such equipment, why not enjoy the advantages of having the best?

Dust-Tight Slip Joint Connections between CONICAL Distributor and stoker hopper with drive gate to shut off the flow of coal to any individual stoker hopper section.

STOCK EQUIPMENT COMPANY
745-P HANNA BUILDING
CLEVELAND 15, OHIO

Specialists in Bunker to Pulverizer and Bunker to Stoker Equipment

Exclusive WITH THIS "UNIVERSAL" HEAT EXCHANGER

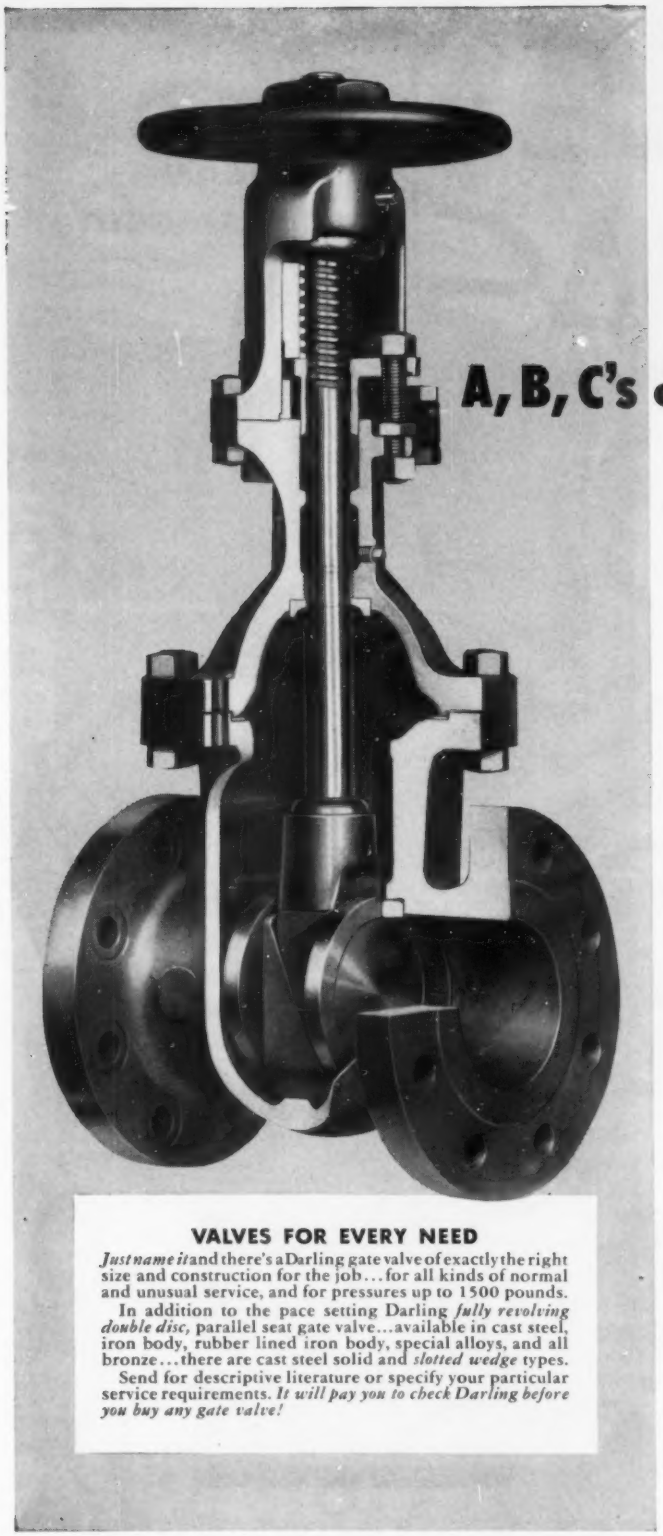

Exclusive
separately removable shell cover
Exclusive
fin-and-tube assembly available in any desired metal or alloy
Exclusive
fins mechanically bonded to tubes
Exclusive
simple closure containing only 3 parts
Exclusive
return bends available with patented unions
Exclusive
complete design backed by 85 years of experience
Exclusive
design and construction proven by more than 75,000 installed units
Exclusive
designs available for pressures up to 10,000 psi and higher

These exclusive features, together with many distinctive advantages, have made the G-R Twin G-Fin Section more widely used on cooling, heating, condensing and heat exchange services than any other design of heat transfer apparatus. Write for bulletin.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

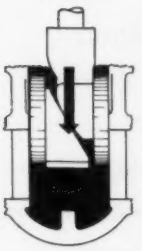
G-R HEAT TRANSFER APPARATUS **Twin G-Fin Section**

GR310



DARLING VALVES

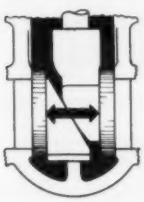
A, B, C's of better valve service with DARLING Revolving Disc GATE VALVES



GATE DESCENDING

A EXTRA LIFE

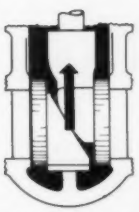
Fully revolving discs, independently hung, change seating position at each closing, assuring uniform wear distribution for prolonged service. Plain "no pocket" discs are interchangeable for *extra* life!



GATE CLOSED

B POSITIVE CLOSING

Faces of the upper wedge are radiused and faces of both wedges are transversely beveled for equalized wedging pressures and tight closing despite valve body distortion.



GATE RISING

C EASIER OPERATION

Wedging pressure on both discs is released before discs start to rise. Complete absence of wedging pressure during travel of discs assures easy operation and greatly prolonged valve life!

VALVES FOR EVERY NEED

Just name it and there's a Darling gate valve of exactly the right size and construction for the job... for all kinds of normal and unusual service, and for pressures up to 1500 pounds.

In addition to the pace setting Darling *fully revolving double disc,* parallel seat gate valve...available in cast steel, iron body, rubber lined iron body, special alloys, and all bronze... there are cast steel solid and *slotted wedge* types.

Send for descriptive literature or specify your particular service requirements. *It will pay you to check Darling before you buy any gate valve!*

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario

SIMPLE AS

Getting profitable life from castings which must face heavy abrasive service is simple as A B K.

ABK Metal castings stand up better and last longer because of carefully controlled metallic structure and specified hardness (500 to 700 Brinell). Because ABK Metal has those extra qualities that ordinary "abrasion resistant" metals lack, you can expect up to seven times greater service from ABK Metal castings.

The extra life of ABK Metal castings saves you dollars both in replacement parts and labor—cuts downtime, increases your operating efficiency. Let us show you how ABK Metal, an exclusive Brake Shoe product, can solve your abrasive wear problems.

2166

AMERICAN Brake Shoe COMPANY

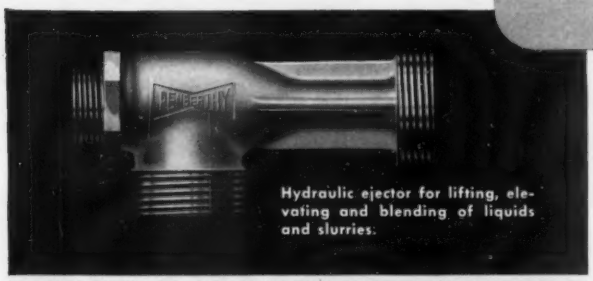
CHICAGO • HOUSTON • ST. LOUIS • SAN FRANCISCO • TOLEDO

BRAKE SHOE AND CASTINGS DIVISION

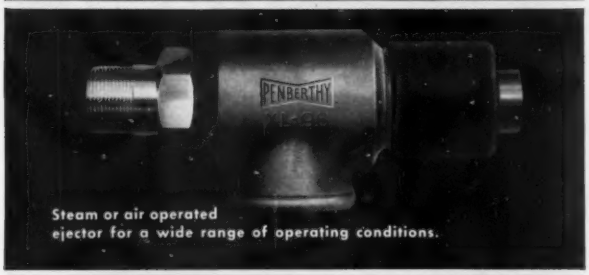
230 Park Avenue, New York 17, N. Y.

LOW COST...
COMPACT...
TROUBLE-FREE...

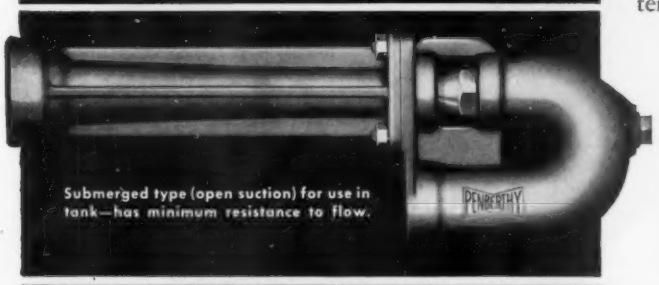
PENBERTHY
JET PUMPS



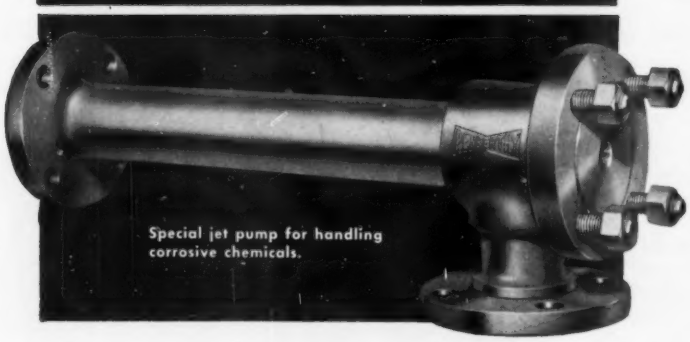
Hydraulic ejector for lifting, elevating and blending of liquids and slurries.



Steam or air operated ejector for a wide range of operating conditions.



Submerged type (open suction) for use in tank—has minimum resistance to flow.


Special jet pump for handling corrosive chemicals.

Consider the simplicity of the jet pump. It uses steam, water, air or gas under pressure to transfer or mix, without clogging, *any liquid which will flow through pipes.* It has no moving parts or packing glands. Needs no lubrication or maintenance. It's practically noiseless, costs little and is compact.

Penberthy makes a full range of jet pumps. They are being used in standard and unusual applications. Where necessary, they are made to withstand corrosion, contamination and high temperatures.

Penberthy, from wide experience, can help you save time and money, increase the efficiency of your operation. Take the first step by writing for Bulletin No. 512 which details the complete line of jet pumps by Penberthy.

★

Established 1866

PENBERTHY INJECTOR COMPANY

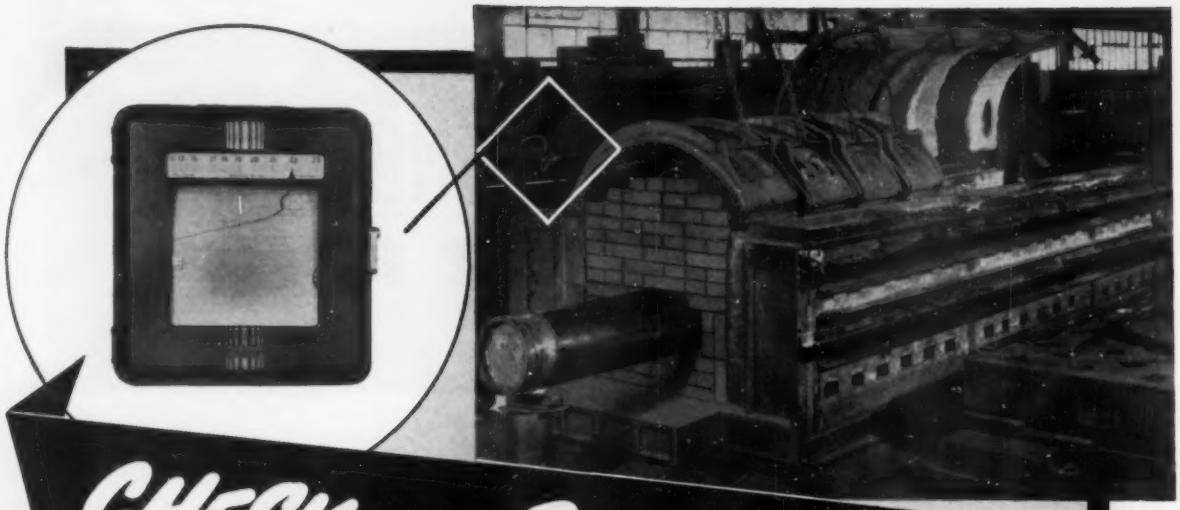
Division of the Buffalo-Eclipse Corporation

1242 Holden Avenue
Detroit 2, Michigan

There's Certain satisfaction in **PRODUCTS BY**

PENBERTHY

- **CYCLING JET PUMPS**
- **EJECTORS**
- **INJECTORS**
- **ELECTRIC SUMP PUMPS**
- **EDUCTORS**
- **EXHAUSTERS**
- **SYPHONS**



CHECK and DOUBLE CHECK

at
Pittsburgh Piping
and
Equipment Company

on HEAT TREATING and BENDING TEMPERATURES

The temperature to which P.P.&E. piping is subjected before bending is measured by a Ray-o-Tube which projects through the furnace wall . . . and recorded on the chart of the Micromax instrument.

This time-temperature record makes practicable precise control of conditions so that each section of pipe is heated in conformance with a predetermined routine which assures consistent physical and mechanical properties.

After the pipe is taken from the furnace, it is immediately placed on a bending table, and during the bending process its temperature is periodically checked with an optical pyrometer by a trained, experienced observer.

You can depend on Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

Pittsburgh Piping
AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Atlanta . . . . . Whitehead Building	Cleveland . . . Public Square Building
Boston . . . . . 10 High Street	Houston . . . Heights State Bank Bldg.
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PP-1

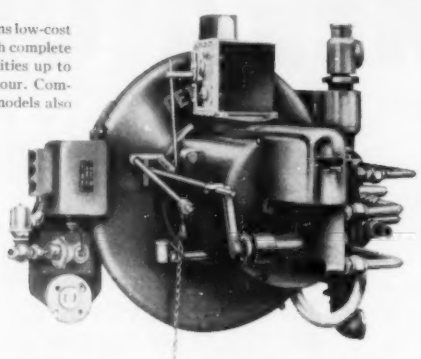
Is inefficient firing stealing dollars from your pocket?

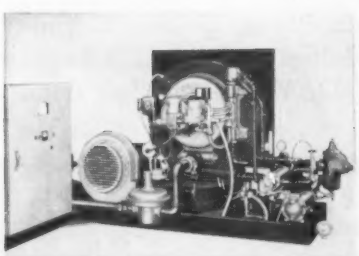
install a

PETRO INDUSTRIAL OIL BURNER

and save 3 ways

Rotary type. Burns low-cost heavy fuel oil with complete reliability. Capacities up to 200 gallons per hour. Combination oil-gas models also available.





Petro "Packaged Unit" (for oil or gas or both). A complete combustion system in which all elements are correctly balanced and integrated. Simply bolt to boiler front and make service connections and it's ready to go.

Send for free catalog today . . .

see our catalog in Sweet's ARCHITECTURAL FILE or write for copy

1. Fire low-cost oils

Petro fires the heavy fuel oils (Nos. 5 and 6) which average 8% richer in heat value than the light burner oils, and cost less per gallon.

2. Save fuel and labor

They efficiently fire heavy oils with complete dependability, following load changes automatically. This makes fuel go farther and saves labor.

3. Low maintenance cost

They are sturdily built and thoroughly reliable. This means low maintenance costs.

There's a Petro burner to fit almost every boiler, in sizes from 11 to 200 gallons per hour.

Heating contractors everywhere recommend and install Petro oil equipment. For illustrated catalog write Petro, 3018 West 106th Street, Cleveland 11, Ohio.

In Canada, write 2231 Bloor Street West, Toronto, Ontario.

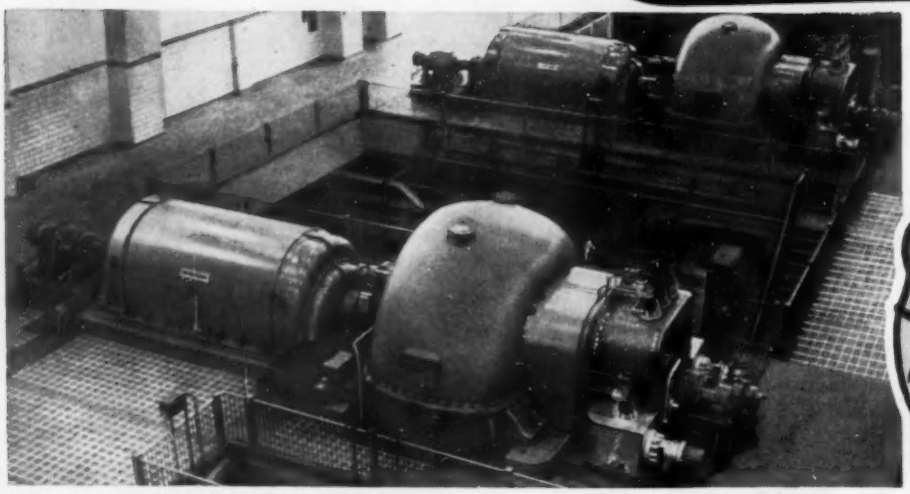
Residential Oil and Gas Burners, Oil and Gas Furnaces and Boilers, Industrial and Commercial Oil, Gas and Oil-Gas Combination Burners

PETRO

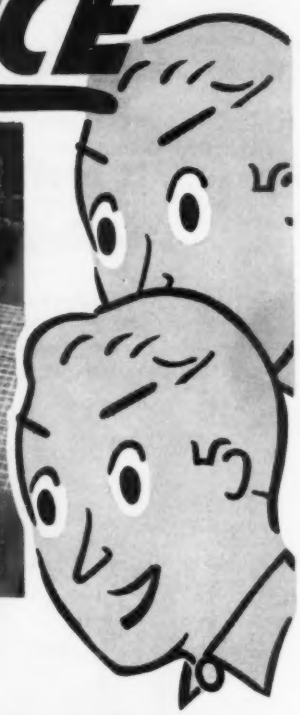
T.M. REG. U.S. PAT. OFF.

Over 50 Years of Leadership in Automatic Heating and Power Equipment

you'll look *TWICE*



Brown Boveri 25,000/32,500 kW turbo-generator sets. The City of Cleveland saved enough on the two new units to purchase a third generator, if so desired. They were produced and delivered as scheduled.



at BROWN BOVERI TURBO-GENERATORS

WHEN you realize the basic economies of Brown Boveri turbo-generators embrace *all* of these eight points . . .

1—Top Efficiency
2—Long Life
3—Minimum Maintenance
4—Thorough Dependability
5—Compact Design
6—Low Initial Cost
7—Prompt Delivery
8—Complete Service Facilities

. . . *plus,* of course, world-famous Brown Boveri quality. . . you'll want to take a *second look* at this outstanding equipment (*and give it serious consideration*) by writing TODAY for complete data.

BROWN BOVERI

BROWN BOVERI CORPORATION

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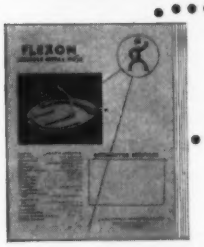
SALES OFFICES: Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Butte, Mont. • Chicago, Ill. • Cleveland, O. Denver, Colo. • Detroit, Mich. • High Point, N. C. • Jacksonville, Fla. • Kansas City, Mo. Knoxville, Tenn. • Lewiston, Me. • Los Angeles, Cal. • Minneapolis, Minn. • New Orleans, La. New York, N. Y. • Portland, Ore. • San Francisco Cal. • Seattle, Wash. • Tucson, Ariz.

WHEREVER rigid piping must be connected to machinery

USE FLEXON METAL HOSE



YOUR GUIDE TO MOTION CONTROL

Catalog 130R gives specifications for all types of FLEXON hose. Write for a copy or see the Flexonics catalogs in Chemical Engineering Catalog and Sweets Plant Engineering File.

By using Flexon Metal Hose as the connecting link between rigid pipe and machinery, you solve two otherwise serious problems—the elimination of damage to the piping because of vibration and the compensation for any misalignment that may exist. Properly installed, Flexon Metal Hose will give long, dependable, trouble-free service without further attention.

Whatever your flexible connection problem, there is a Flexon hose type to meet your needs. Corrugated and convoluted types are available in a wide variety of designs and in a complete range of sizes. Flexon Metal Hose is offered in steel, bronze, stainless steel and other alloys to fill your requirements. Your Flexonics distributor will give you further data. Look for his name in your classified telephone directory or we will send it to you.

Flexonics Corporation CHICAGO METAL HOSE DIVISION
1301 S. THIRD AVENUE · MAYWOOD, ILLINOIS

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Flexon identifies products of Flexonics Corporation that have served industry for over 52 years.

Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows

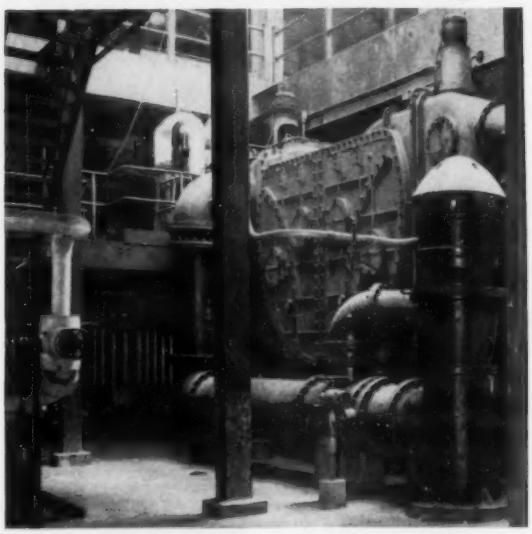
NOTES

for the engineer's note book

. . . ON WHEELER-ECONOMY POWER PLANT EQUIPMENT

NO SHUTDOWN, NO LOAD REDUCTION, NO HAND CLEANING . . . WITH C. H. WHEELER *REVERSE FLOW* CONDENSERS

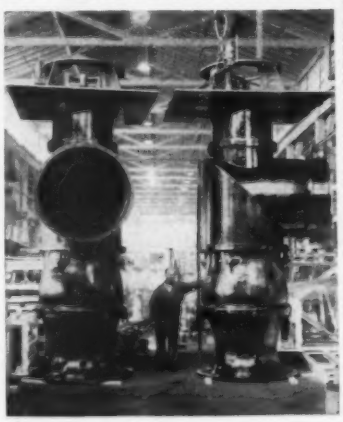
The savings in dollars and downtime effected by C. H. Wheeler's Reverse Flow design for steam condensers are a matter of record in public utilities and private power plants throughout the country. Chances are, you can inspect a nearby installation and learn first hand how efficiently debris of vegetable, animal and mineral matter is dislodged from the tube sheet and flushed away by reversing the flow of the cooling water through the Condenser. Cleaning work that formerly took hours is accomplished in minutes with no interruption in load. C. H. Wheeler custom-engineers your steam condensing hook-up to pay off in long range sustained efficiency. (Bulletins mailed on request.)



WHEELER - ECONOMY CIRCULATORS

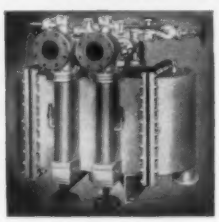
Lasting Dependability
Minimum Maintenance

Wheeler-Economy Circulators include: mix-flow vertical wet pit type with both standard and pull-out design; vertical mix-flow volute type for dry pit installations; and horizontal single stage centrifugal constructions to 100,000 GPM capacities. Wheeler-Economy pumps for general service include: single stage high head double suction; multi-stage with horizontal or vertical split case; pumps for sump, process and fire protection services. Wheeler-Economy also invites your special problems requiring custom design. (Bulletins mailed on request.)



TUBEJET AIR EJECTORS

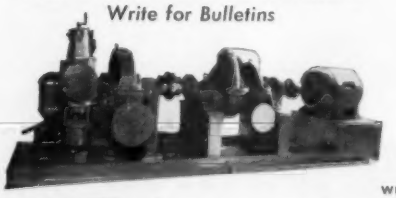
Steel Shell
More Reliable



C. H. Wheeler Steel Shell Tubejet Air Ejectors provide worthwhile savings in space and weight. They are available with either single or multiple element, two-stage type with combined surface inter-after condenser. Write for Bulletin.

WHEELER-ECONOMY CONDENSATE PUMPS for Condenser Service with Turbine and Motor Drive

Write for Bulletins

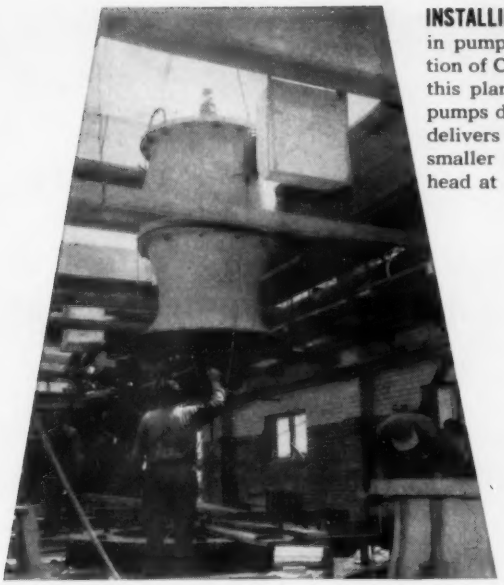


WE-400

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration
High Vacuum Process Equipment • Micro-Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery.



INSTALLING NI-RESIST DIFFUSER AND SUCTION BELL in pump at the new Astoria electric generating station of Consolidated Edison. Condenser equipment in this plant includes 54″ x 60″ salt water circulating pumps driven by 400 h.p. motors at 233 r.p.m. Each delivers 68,500 g.p.m. with a 16′ dynamic head. Four smaller pumps are rated at 8,000 g.p.m. with 100′ head at 880 r.p.m.

NI-RESIST DIFFUSER WEIGHING 10,280 lbs. . . . in center, is shown along with diffuser and suction bell of small pump. Economy Pumps Inc., Div. of C. H. Wheeler Mfg. Co., Philadelphia, fabricated the pumps, using more than 88,000 lbs. of Ni-Resist supplied by Advance Foundry Co., Dayton, Ohio.

Consolidated Edison specifies

NI-RESIST...

for Corrosion Resistance

There is a growing trend away from ordinary cast iron for components of circulating pumps and valves used in handling condenser coolants . . . particularly salt water from harbor or seaboard . . . because of the corrosion and erosion encountered.

The action of Consolidated Edison in specifying Ni-Resist® is typical.

In selecting materials for their new Astoria electric generating station, Consolidated Edison engineers gave major consideration to the need for resisting corrosive attack from the polluted brackish water of New York harbor, since this water contains a high content of industrial wastes and varies in temperature between 30° and 85° F.

Obviously, continuous operation of the station depends upon a steady, uninterrupted flow of cooling water through the condensers. Use of Ni-Resist helps to assure this by providing exceptionally high resistance to corrosion and erosion at moderate cost.

Ni-Resist is also suitable for steam service up to 600° F., and shows up to 10 times better scaling resistance, and up to 12 times better growth resistance than plain cast iron at 1300 to 1500° F.

These are but a few of the advantages you may obtain from Ni-Resist. *Actually, no other cast metal provides such a useful combination of engineering properties.*

Several types of Ni-Resist are available to meet a variety of industrial demands. Get full information . . . mail the coupon now.

EMBLEM OF INCO SERVICE

The International Nickel Company, Inc.
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THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

SAFETY M.I. WIRING SYSTEM

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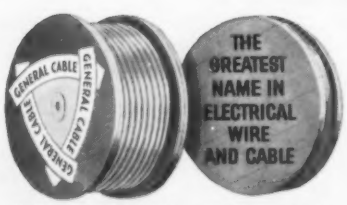
THE WORLD'S NEWEST, MOST VERSATILE ELECTRICAL WIRING!



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1953 Code Approved for wiring jobs up to 600 volts, Safety m.i. Wiring has proved its versatility for power, lighting and control. In power plants, industrial and commercial buildings, processing plants, ships and in dozens of other applications where deterioration is a major problem.

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9th BIG NORDBERG DIESEL for PONCA CITY, OKLAHOMA

"Ponca City has been *TAX FREE* for 20 years... aided by Modern Diesel Power..."

says Mr. PAT SCHLESINGER
Plant Superintendent

• During the past ten years, the Ponca City Light Department has earned net profits approaching *FIVE MILLION DOLLARS.* These profits have financed all plant expansion and civic improvements and have paid practically all the costs of local government. Ponca City has been *TAX FREE* for the past 20 years.

The secret behind this impressive record lies in sound, efficient management and the reliable, low cost operation of Nordberg Diesel and Duafuel® power. With this successful background, it was natural that when Ponca City needed more power, officials again turned to Nordberg . . . and placed a repeat order for their NINTH engine . . . a new 5,135 hp Duafuel® unit which brings the total supplied capacity up to 22,660 horsepower—all *Nordberg.*

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P154

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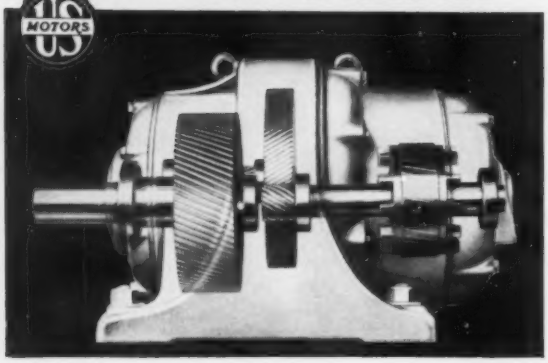

The motor that internally gears its speed

DON'T go to the expense of installing a gear box with extra coupling and guards to rig up slow speed for a motor. Install the *U. S. Syncrogear motor* and avoid extra contraptions. You'll simplify your power hook-up, save space, eliminate hazards and give your driven machine the most efficient power. The U. S. Syncrogear motor was one of the first complete integral power units, introduced 22 years ago. It's backed by experience, tested and proved performance and engineering "know-how" that only U. S. MOTORS can offer to those seeking the most dependable geared motor power.

SYNCROGEAR ADVANTAGES

- Compact—rugged—quiet
- No external gear box
- No extra coupling
- Internally-geared
- Single unit on one base
- Completely housed
- Reduced frictional losses
- Permanently-aligned parts
- Super-hardened gears
- Pyramidal supporting base
- Solid shank pinion
- Normalized castings
- Extra large oil reservoir
- Asbestos-protected windings
- In-a-line shaft
- Neat, streamline appearance
- Drip-proof surface

U.S. SYNCROGEAR MOTOR 4 TO 10,000 RPM. 1/4 TO 30 H.P.

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U. S. ELECTRICAL MOTORS INC. PO-3
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COMPANY_____

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BLACKMER
PUMPS
1904-1954
50th Year

a story of growth

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Blackmer's growth has been earned by the development and manufacture of products backed by 50 years of constant laboratory and field research. These products include industrial bulk pumps, truck pumps, hand pumps, strainers and fluid motors. Blackmer's advanced design, smooth operation, economy, and flexibility of use . . . have been performance proved throughout the last half century. Wherever liquids are handled, Blackmer pumps are known for quality, dependability and record durability. And now, new products soon to be announced promise a new standard of performance. Our engineers can solve your liquid materials handling problems . . . write for details today!

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INDUSTRIAL • CHEMICAL • AIRCRAFT

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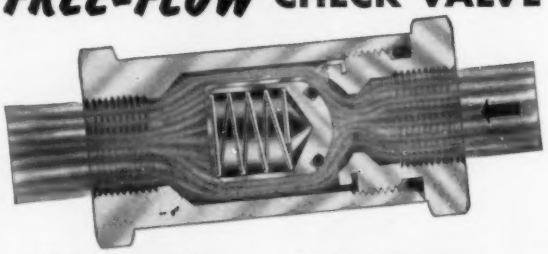

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- Leakproof "O" ring seal
- ¼ psi Opening pressure
- 0 to 3000 psi service
- Small in size
- Aluminum alloy, brass—Other materials to order
- Sizes ⅛" to 1"
- Any combination of tube and pipe ports.

Write for complete catalog and nearest distributor.

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RM REPUBLIC MANUFACTURING CO.
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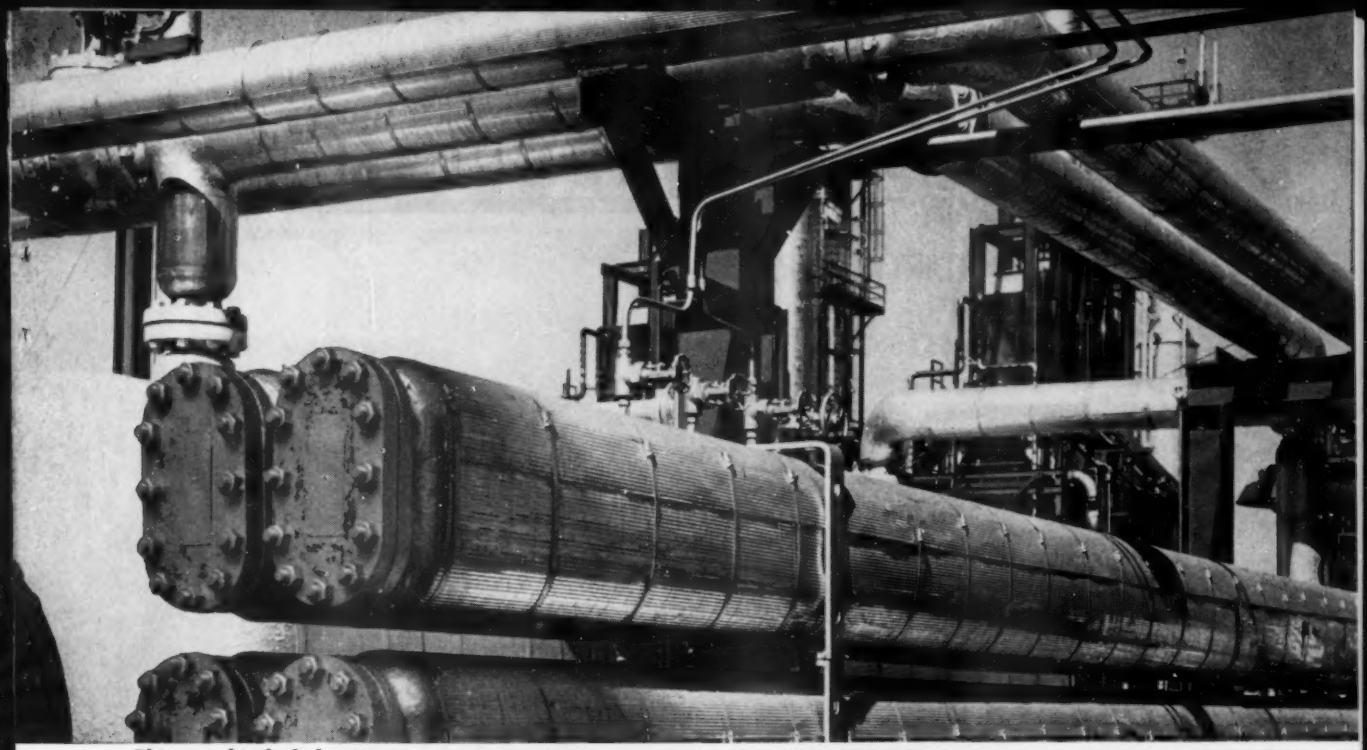


This new kind of aluminum jacketing is used in more and more outdoor processing plants to protect insulated towers, vessels, lines—it eliminates costly maintenance and replacement of old-fashioned coverings. Engineers report that Childers Jacketing has advantages not found in expensive heavy sheet aluminum, costs less to buy, far less to apply.

New Aluminum Jacketing Protects Insulated Lines...Cuts Costs 28%

How 986 of America's Leading Companies Saved Money By Weather-proofing Insulated Lines This New Way:

A two-man crew can apply the jacketing fastest. Only tools are a pair of pliers and a wedge or screw driver as shown here. Note how easily the jacketing forms around the pipe.

Aluminum strapping can be pulled plenty tight enough with just pliers like this. No special strapping tool needed. Strapping is pulled down between lugs and bent over.

Up-to-date appearance, low cost, and long life go hand in hand in a new aluminum jacketing for insulated lines. Developed by Childers Manufacturing Co., Houston, Texas, it is the first permanent weather-proofing that offers both low initial cost and low application cost.

Childers Jacketing, made of tough 3S aluminum alloy for maximum corrosion resistance, lasts years without painting or other maintenance. It costs less than even the cheapest kind of weather-proofing, when the cost of one paint job is considered. Savings run up to 28%.

Cost-minded engineers are also impressed with tne gleaming beauty of Childers Jacketing that means "good plant housekeeping."

Available with moisture barrier attached, for use over 85% magnesia insulation.

5 years of tests and major installations in 986 of America's leading processing plants, refineries, and power plants have proven the advantages of Childers Aluminum Jacketing over other types.

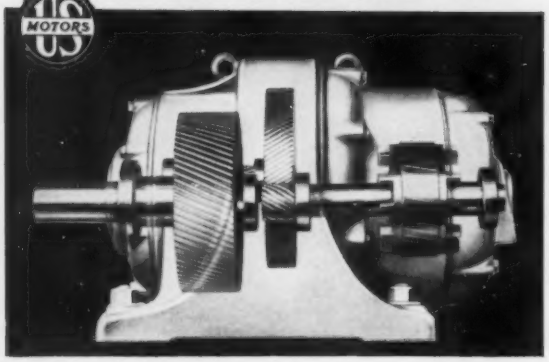
Try this low-cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation.

Address Childers Manufacturing Co., Dept. PO-7, 3620 W. 11th St., Houston 8, Texas.

Engineering representatives in all principal cities to work with you on your problems.

This is how the flexible, easy-to-handle Childers Jacketing arrives at the job site. It is in convenient rolls 4 feet wide and 100 feet long—just right for one man to handle—and is available either with or without a moisture barrier attached on the back of the .006" aluminum "skin." It can be cut to proper lengths using any flat table and a straight-edge. (Advertisement)

Geared Power
SIMPLIFIED WITH
SYNCROGEAR



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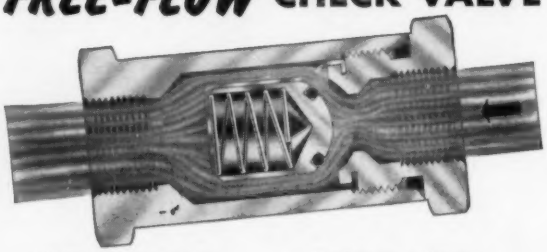

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- Small in size
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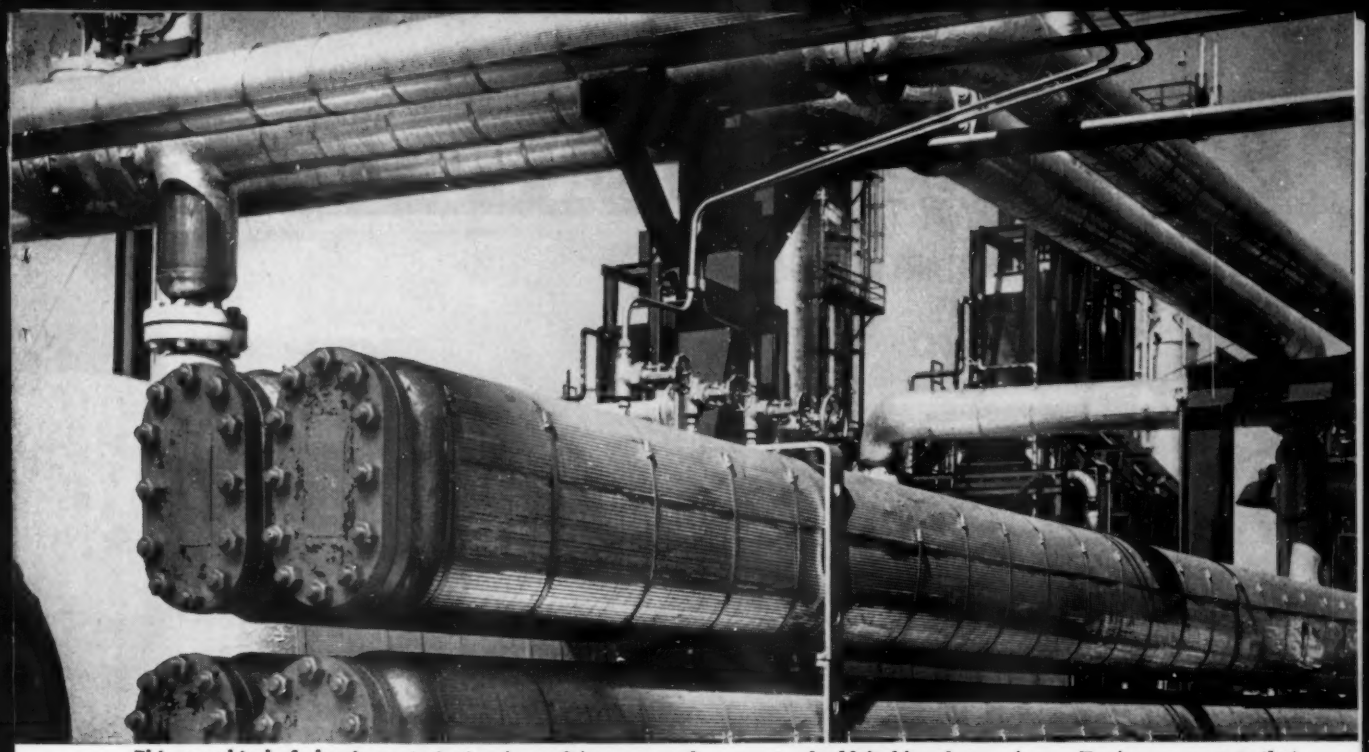

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20 SIZES...
10 to 600 h.p...
15 to 200# OIL OR GAS

AMESTEAM GENERATOR

This automatically controlled packaged boiler unit includes:

★ all piping and wiring, ready for your service connections.

★ fan, feed water pump, condensate tank, injector, blow-off valve, necessary refractories, insulation and metal jacket.

ALL YOU NEED is fuel tank, gas vent and service connections.

—AND YOU KEEP RIGHT ON SAVING

with these trouble-free, fully automatic units with their eye-level controls, their accessibility inside and out, and fuel-saving 80% guaranteed efficiency!

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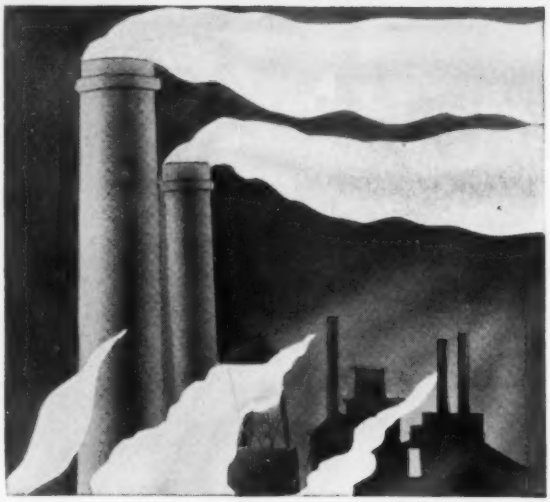

Study Of Meteorological Conditions Above New Plant Site Urged

Looking for a new plant site? To buy or build? Then take the word of industrialists and scientists, who are using the newest techniques in the study of air contaminants:

Study the meteorological conditions at various altitudes as well as ground level.

Knowledge of temperature, humidity, time, windspeed and direction can save you money.

Bendix-Friez, foremost maker of meteorological instruments in the world, offers all its facilities and experience with industries, to help you find a practical approach to minimize your air pollution problems . . . now or before they start without costly moderation of present equipment. Write for further information.

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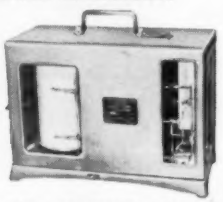

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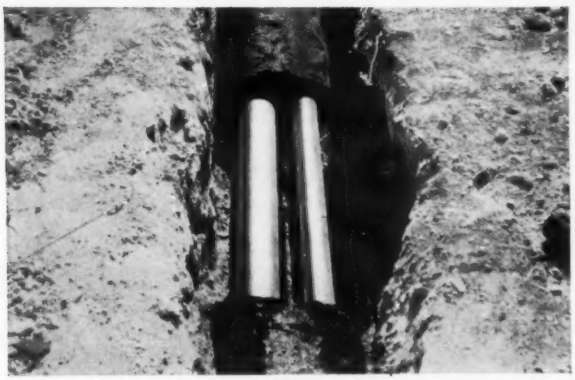
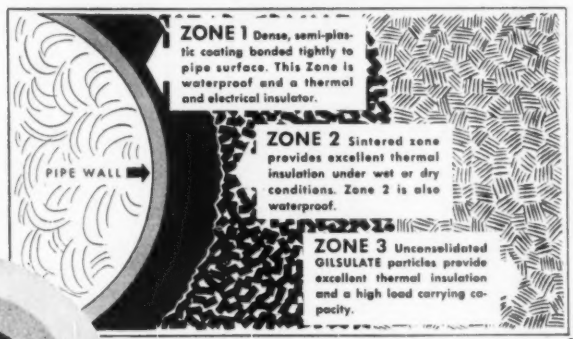
more and more hot underground pipe gets insulated



2. GILSULATE—Cost Less per Installed Linear Foot—No skilled labor needed...requires no mechanical sheaths, special protective devices, or costly installation procedures.

with new modern triple-zone GILSULATE®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PIPE WALL

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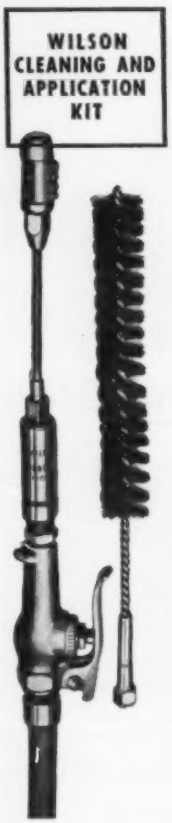
the Wilson Way

Usually a surface condenser tube fails in the first few inches of its length due to inlet end erosion. To protect against this costly deterioration, it is good practice to paint the tube sheets as well as the tube ends with a protective coating. This low-cost cleaning and application kit is designed to do the job quickly and efficiently. Only three simple steps are needed: (1) Clean all the tube ends. (2) Thin coating and squirt it into tube. (3) Attach the paint brush to the air motor and use it for fast, easy spreading.

This Wilson method insures complete removal of dirt, provides excellent paint adherence, makes certain paint is spread evenly on the tube. The work can be done in a hurry . . . with any labor available.

The Wilson Cleaning and Application Kit is but one of many Wilson accessories designed for the proper maintenance of condensers and heat exchangers. For packed condensers, there are packing tools, packing removal counterbores and ferrule wrenches. Wilson also makes a wide range line of tube cutters, tube expanders, flaring and belling tools, tube pullers, etc. TW 822



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TUBE CLEANERS • TUBE EXPANDERS

GLASS COATED STEEL TUBING

Low-Cost solution to

PREHEATER TUBE outage!

*"Corrosion can be prevented by using materials that are not attacked by sulfuric acid. Special glass appears to offer good possibilities . . ."

Barrows is now producing, and has placed in use, glass coated, long lengths of tubing up to 3" in diameter. Field tests prove long term protection for preheater tubes now possible with glass coatings.

*"Progress in air-preheater design demands that the temperature of the exit flue gases be lowered considerably below those now attained."

Barrows glass coated preheater tubes will handle lower flue gas temperatures. Lower temperatures mean increased efficiency.

*Reprinted from Bureau of Mines Report of Investigations 4996

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Barrows, one of the oldest and best known names in the Porcelain Enamel industry, invites your inquiry. It will receive the personal attention of a Barrows engineer.

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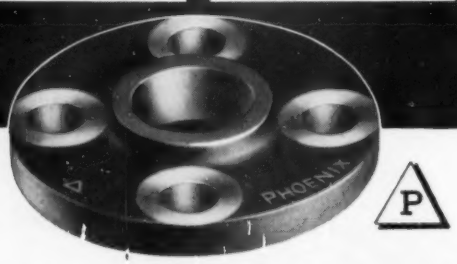
LANGDON ROAD & PENN. R. R., CINCINNATI 13, OHIO

PHOENIX *Drop-Forged* FLANGES MEAN . . .

MAXIMUM STRENGTH



Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

NEW CATALOG!

Send for free brochure showing Phoenix Complete Line.

FLANGE DIVISION

PHOENIX MANUFACTURING CO.

Catasauqua, Pa. • Joliet, Ill.

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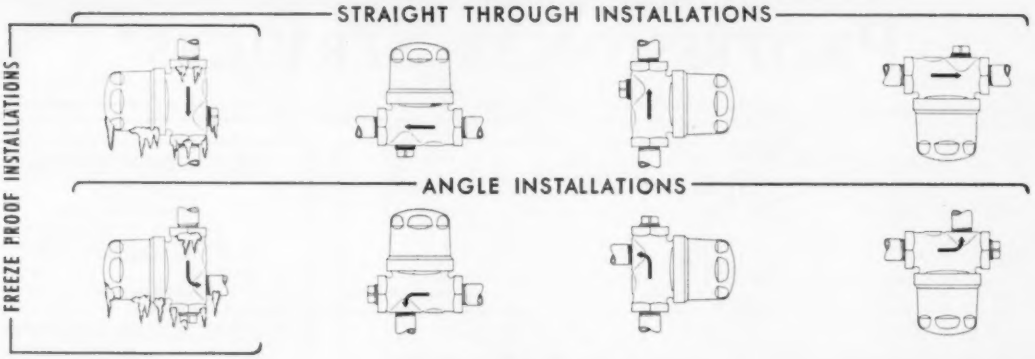
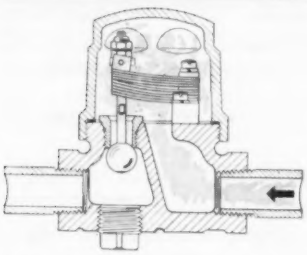
DESIGNED TO SAVE YOU MONEY ON INITIAL INSTALLATION AND MAINTENANCE COST

A RECORD OF PIPING VARIATIONS WITH ONE TYPE AND DUAL OUTLET



HOW IT WORKS



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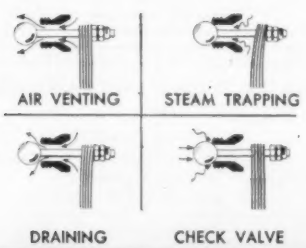

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NO EXTRA FITTINGS NEEDED AS TRAP CAN BE INSTALLED IN ALL POSITIONS

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NO SEPARATE CHECK VALVE

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NO SEPARATE AIR VENT

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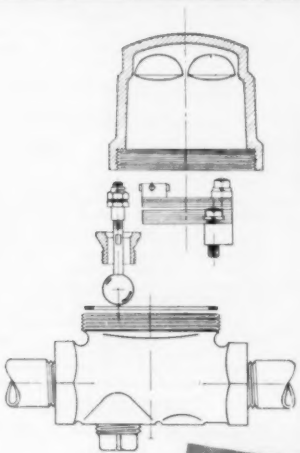
CAN BE FRESET TO DISCHARGE CONDENSATE AT PREDETERMINED TEMPERATURES

SIMPLE SERVICING IN LINE



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HILL PUMP VALVES

Since 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

STOP *that* WATER

With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. 33 in 55's. Free sample. See Sweet's.
HAYNES PRODUCTS CO., OMAHA 3, NEBR.

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

Classified Advertising
POWER

PROFESSIONAL SERVICES

AMERICAN HYDROTHERM CORP.
Thermo Engineers
HIGH TEMPERATURE WATER SYSTEMS FOR DISTRICT AND INDUSTRIAL HEATING
Universities, Hospitals, Military Bases, Housing Projects; Plant Process and Space Heating; also Power Generating Plants with Heat Distribution Requirements.
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PETER F. LOFTUS CORPORATION
Engineering and Architectural Consultants and Designers
First National Bank Bldg.
Pittsburgh 22, Pennsylvania
Cable Address—"LOFTUS Pittsburgh"

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
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Mechanical — Electrical — Civil
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Consulting Engineers
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Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
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PUMPING PLANTS—ELECTRIC SYSTEMS
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J. E. SIRRINE COMPANY
Engineers
Power Plants — Consultations
Design — Reports
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FRED L. PEARSON and ASSOCIATES
Consulting Engineers
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Woodward 5-0133

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
Power Plants
Steam — Diesel — Hydro
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GILBERT ASSOCIATES, INC.
Engineers • Consultants • Constructors
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Engineering and Design • Construction Supervision
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Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
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SYSKA & HENNESSY, INC.
Engineers
Consultation — Plans — Reports
Power Plants — Disposal Plants
Water Systems
114 East 39th Street
New York, New York

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
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74 New Montgomery St., San Francisco 5, Calif.

SANDERSON & PORTER
Engineers and Constructors
New York • Chicago • San Francisco

WATER SERVICE LABORATORIES, INC.
Specializing Since 1927
Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
New York—Philadelphia—Washington, D. C.

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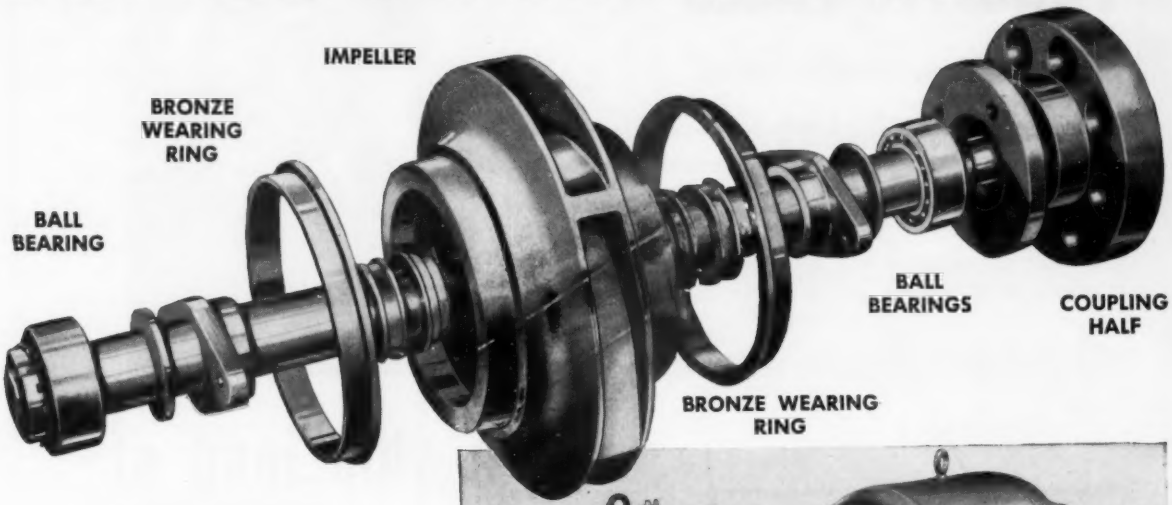
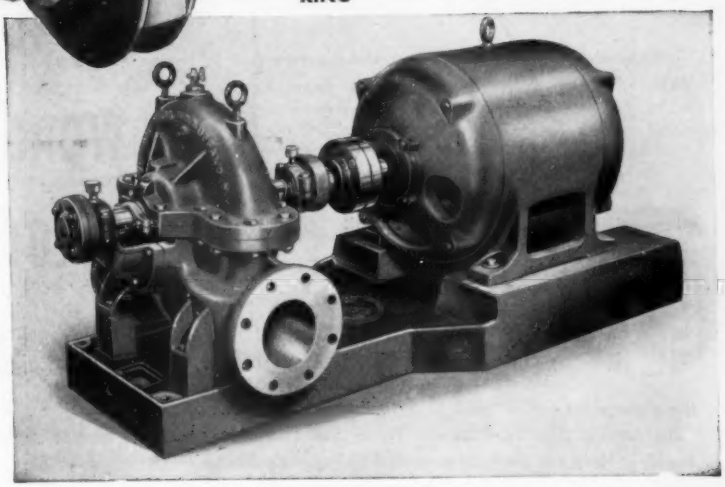
Engineers - Constructors - Consultants
Power Plant Specialists
Utility — Industrial — Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

INSIDE STORY OF A BETTER PUMPING VALUE





IMPELLER-AND-SHAFT ASSEMBLY OF A "BUFFALO" DOUBLE SUCTION PUMP

Take a look at the "heart" of a clear water pump that is built for performance and endurance! Note the oversize shaft and ample ball bearings to stand the severest continuous-service strains. The double suction enclosed impeller is hydraulically balanced and has vanes and shrouds shaped for maximum efficiency. The two large bronze wearing rings on either side of the impeller prevent leakage, thus keeping efficiency high.

And in the pump casing, water passages are simply formed with ample area to avoid friction losses and sudden changes of velocity. (Top half of casing is easily removable without disturbing piping, for quick servicing of impeller and stuffing boxes).

Here is a pump that cuts your costs where economy really counts—in continued high efficiency, in freedom from breakdowns, in easy maintenance and the kind of lifetime performance you need on your pumping job. Write for Bulletin 955-P and check construction data on these pumps in sizes from 10 to 14,000 gpm.

•

"Buffalo" PUMPS

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

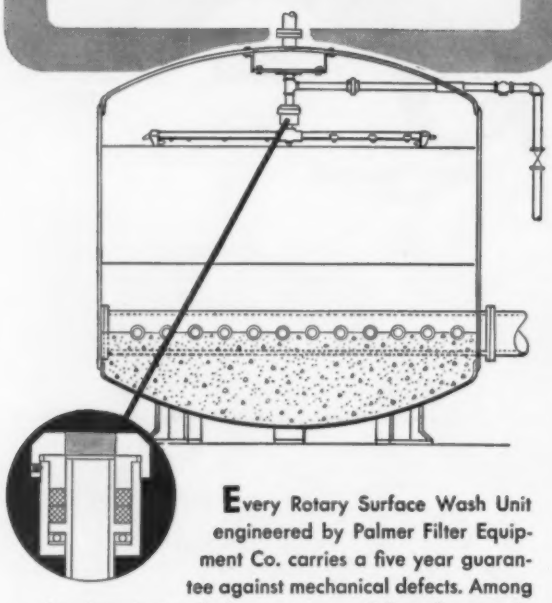
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

PALMETTO-PALCO®

The Packing Palmer Picked

~~to~~ **SAFEGUARD**

a **GUARANTEE**



Every Rotary Surface Wash Unit engineered by Palmer Filter Equipment Co. carries a five year guarantee against mechanical defects. Among the champions called upon to save Palmer from costly field service trips is Palmetto Palco Self-Lubricating Packing. Here are the facts as stated by Palmer's design chief:

"The performance of Palco Packings in thousands of Palmer Rotary Surface Wash Unit Bearings has been outstanding. These units are installed in open gravity and pressure filters handling both hot and cold water and certain types of chemical solutions. Conditions involve extreme temperature ranges with no possibility of lubrication since this would contaminate process liquids. Palmetto Palco has been used exclusively for 14 years with no replacements required due to packing failure even in the original units; it has helped us maintain our five year guarantee with minimum time and expense."

For better performance records in *your* equipment, investigate Palmetto Packings—Self-Lubricating, Sheet or Molded. Write for Catalog PC-102 today!

packing more performance into every application

PALMETTO Packings

GREENE, TWEED & CO. North Wales, Pa.

a ship load of wonderful Marmaduke stories and only $1

Here are 21 of Marmy's most fabulous engineering exploits, exactly as they appeared in the pages of POWER. Generously illustrated and bound in varnished red cover. It's a collection any engineer will want to read and re-read. Only one dollar, postpaid. Supply is limited, order today.

POWER
330 West 42 St., New York 36, N.Y.

Enclosed please find $_____ for which send me _____ copies of "The Marmaduke Story" at $1 per copy.

NAME _____

FIRM _____

ADDRESS _____

CITY _____ STATE _____

Mechanical Engineers

Power Plant

Large engineering and construction firm offers staff positions to qualified Mechanical Engineers. These positions are permanent and generous company benefits are included. Salary is commensurate with experience and education. Work involves plant betterment and supervising starting, testing, operating and correcting troubles of Steam Electric Station equipment. Considerable travel is required. A technical education is preferred and power plant operating or betterment experience necessary.

PLEASE GIVE COMPLETE DETAILS OF BACKGROUND, INCLUDING: EDUCATION, EXPERIENCE, PERSONAL DATA AND SALARY DESIRED.

All replies will be promptly acknowledged.

P-1377, POWER

330 W. 42nd St., New York 36, N. Y.

Address to office nearest you
REPLIES (Box No.):
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

WANTED—MECHANICAL Engineer with at least ten years experience in the operation and maintenance of refrigeration equipment and air handling equipment for position as Building Engineer to operate "heat pump" system in largest office building in New Mexico. College graduate preferable but not essential. In reply give full details regarding experience, education and salary expected. Savage & Sganzini, 215 Fourth St., S. W., Albuquerque, N. M.

SELLING OPPORTUNITIES OFFERED

SALES ENGINEERS, with a knowledge of steam boiler operation and maintenance and experience in selling to the industrial heating and power plant trade, are wanted for permanent service in choice territories in various states. Assignment involves the sale of a combustion type triple action fuel oil conditioner, to commercial and industrial plants. High income arrangement on initial and repeat orders assures good substantial year 'round earnings. Address applications to KOR Division, Dept. GW, P.O. Box 485, Gary, Indiana.

WANTED—SALES engineers, openings in several territories for experienced Sales Engineers by large producer of southern low and high volatile coals. Young men preferred. Salary open. Excellent opportunities for men who can qualify for sales and service contacting Power Plant Engineers and Purchasing Agents. All replies will be kept confidential. SW-1649, Power.

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

(Continued on the following page)

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT: BUSINESS: **"OPPORTUNITIES"** EQUIPMENT USED OR RESALE

—RATES—

UNDISPLAYED

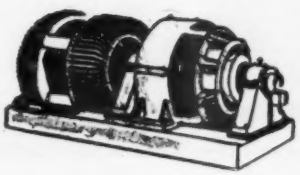
$1.50 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted undisplayed advertising rate is one-half of above rate, payable in advance.
Box Numbers—count as one additional line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

DISPLAYED

Individual Spaces with border rules for prominent display of advertisements.
The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

New Ads: Send to 330 W. 42nd St., New York 36, N. Y. for April issue closing March 5th.

SEARCHLIGHT EQUIPMENT SPOTTING SERVICE



This service is aimed at helping you, the reader of POWER, locate used and surplus new power equipment not currently advertised (this service is for user-buyers only).

First, read the dealer ads on the following pages. A 5-minute study may locate the equipment *now*.

Second, send in the specifications of the equipment wanted on the coupon below, or on your own company letterhead, to

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., N.Y. 36, N.Y.

Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

NO CHARGE • NO OBLIGATION

Searchlight Equipment Spotting Service
c/o POWER
330 W. 42nd St., New York 36, N. Y.

Please help us locate the following used equipment:

.....

.....

.....

.....

NAME ..... TITLE .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

3/54

PROCESS EQUIPMENT LINES

WANTED

FOR SOUTHERN CALIFORNIA

Headq't'rs. Los Angeles—well established. 13th year—this territory. Good volume now for present principals. Can add few good lines by well established M'f'r's. anxious for aggressive, capable experienced Engineering Sales Representation. Lines now:—Steam Jet Ejectors, Steam Vacuum Refrig., Surface and Barometric Condensers, Bag type Dust Filters—Fire Tube Boilers. Good Will with Oil Refiners, Chem. Plants, Food Proc., Cons. Eng'r's. & Contractors result good engineering. Good Service & Good Sales Effort. Owner will stop in Chicago, Detroit, Cleveland, and New York, late April or early May for discussions. Reply

RW-1786, POWER
1111 Wilshire Blvd., Los Angeles 17, Calif.

SENIOR DEVELOPMENT ENGINEER

Established manufacturer of heat transfer equipment needs engineer with 10-15 years experience in design of large power plant boilers. Require knowledge of mechanical design, heat transfer performance, and steam separation methods. Pension program and progressive insurance benefits. Location: Dunkirk, N. Y. Salary open.

Send detailed resume and salary requirement to:

AMERICAN LOCOMOTIVE CO.
Personnel Department
SCHENECTADY 5, N. Y.

WANTED BY LARGE PAPER COMPANY

in Northern Maine

One Turbine Operator experienced in all phases of operation of medium sized Westinghouse Bleeder type Turbines in a Plant of 20,000 Kilowatts capacity.

One Boiler Room Foreman. Must be experienced in the operation of Pulverized coal equipment. Medium pressure, Water Tube Boilers. Steady work. Retirement Plan. Other Benefits.

Please state full qualifications in first letter.

P-1639, POWER
330 W. 42nd St., New York 36, N. Y.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

POSITIONS WANTED

CENTRIFUGAL PUMP Engrg. or Design chief, over 35 yrs. experience producing nearly all sizes and types. Excellent references. PW-1219, Power.

EXPERIENCED SWITCHBOARD Operator would like operating job in central or substation. PW-9867, Power.

SALES SERVICE Engineer young aggressive expr. electrical equpt., automotive, marine industries, engr. Degree, seeking sales management or liaison. Will travel. PW-1783, Power.

TECHNICAL MAN (45) seeks Multiplants Situation as Superintendent of Electrical & Mechanical Power Installations, re: Operations, Preventative Maintenance, Service Engineering, Inspections, etc. Specific Inquires invited. New York City Headquarters preferred. PW-1723, Power.

STEAM POWER Engineer-M.S.M.E. 4 years constructive experience in operation maintenance test and development of power plant equipment. Desire responsible position as assistant to chief engineer. PW-1778, Power.

STEAM POWER Plant; management of operation in U.S.A. or abroad; thoroughly experienced on coal, oil, and gas fuels, industrial and public utility plants, up to 2,000 pounds pressure, 600,000 KW. Good background on erection and starting new plants; some power line construction. PW-1729, Power.

LEFAX POCKET SIZE TECHNICAL DATA BOOKS $1.25 EACH

Printed on loose leaf, six hole, 6¾" x 3¾" bond paper each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and business man.

Architecture	Metals	Transformers,
Home Heating	Gen'l Chemistry	Relays, Meters
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Lumber Data	Television & FM	Machinist's Data
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Write for FREE Catalogs (over 2000 listings). See for yourself how helpful LEFAX can be to you. Send $1.25 for each book, or $6 for any five books listed.

LEFAX DEPT. PM 19, PHILADELPHIA 7, PA.

WE BUY NEW & USED ELECTRICAL SURPLUS

Wire & Cable • Conduit Fittings
Wiring Devices • Switches
Electronic Components • Fuses
Motors • Transformers, Etc.

Phone—Rochester GLenwood 8840

DIAMOND ELECTRIC CO.
P. O. BOX 1632 • ROCHESTER 3, N. Y.

WANTED TO BUY

Two 250 KW and one 500 KW Steam Generating Units, 240 volts. Prefer Skinner, Ames or Chuse. One 300 hp. and one 450 hp. Model 32 E 14 Fairbanks-Morse Generating Units.

A. C. ASKEW
Box 3073 Whittier Station, Tulsa 8, Okla.

$ CASH MONEY $

WE BUY ELECTRIC SUPPLIES • MOTORS • TRANSFORMERS • WIRE • CABLE
SEND LISTINGS
ALLIED ELECTRIC COMPANY
Box 1838—1122 Falls Bldg., Memphis, Tennessee

NEW TRANSFORMERS—25 & 50 KVA

GE, OISC, Distribution Type "H". Form KO2, single ph., 50/60 cy., 33,000 volts primary, 2400/4160Y, 120/240, 240/480, 600 volts secondary, with 4—2½% taps below 33,000 volts, primary cover mounted bushings, secondary tank-wall mounted bushings. S/N 6,900,000.

American Electric Service & Maintenance Co.
Paramount & 2nd Sts., Springfield, Mass.
2-2104; 2-2105
Motors • Generators • Transformers • Sales • Repairs

FOR 6 MONTHS

we have been offering practically all types of Boilers for sale in these columns. Included in our lists are such items as B. & W. Sectional Header Units from 250 HP to 1000 HP.

We still have a number of these fine units available for shipment in ages ranging from 1924 to 1945 manufacture, and in pressures from 200 to 300 p.s.i.

Also ready for shipment are a number of Economic and Package type units in practically all HP and pressure ranges dated from 1940 to 1948.

Almost all of these units have normal accessories and trim. All are available for inspection.

Send us your inquiries. We will reply promptly and fully.

WARNER J. SHERB, INC.

342 Madison Avenue, New York, N.Y.
Telephone MUrray Hill 2-9098

(Specializing in Steam Power, Boilers and Power Plant Engineering since 1917)

ELECTRICAL FUSES

Any Amperage • Any Voltage

We carry on hand the largest surplus stock of electrical fuses in the world. Over 50,000,000 in stock. We guarantee a minimum savings of at least 20%. We invite your inquiries. Specials are our specialty.

Electrical Products Sales Corp.
P.O. Box 546 Hoboken, N. J.

WE BUY SURPLUS FUSES

CONDENSER

1—used Westinghouse Powerhouse Surface Condenser, three pass, 843 square feet, with hot well. No pumps.

PUMPS

1—used McGowan Steam Pump, duplex, 5¼ x 3½ x 5, with bedplate and mechanical lubricator.

1—used National Steam Pump, duplex, 6x4x6. No bedplate or lubricator.

BURFORD, HALL & SMITH
140 EDGEWOOD AVE., N.E.
ATLANTA 3, GA.

500 K.V.A. TURBO-GENERATOR

Moore Non-Condensing Turbine Type S-8 inlet 185 psi. 0-20 psi. Back pressure complete with throttle valve. Back pressure valve and oiling system. Drives through 3965/1200 R.P.M. reduction unit. Westinghouse Generator. 500 K.V.A., 480 volt. 3 phase, 60 cycle, 80% P.F. Direct connected to exciter, 29 amps, 125 volts. Complete with switchgear. Presently connected for 240 volts. May be readily reconnected to 480 volts.

UNITED DISTILLERS OF AMERICA, INC.
595 Madison Ave., New York—PLaza 8-0410

AC MOTORS

HP	Make	Type	Volt	Speed
150	West.	CS	220–440	1750
125	West.	CCL	2200	1140
100	American		220–440	1750
75	A. C.	AR	220–440	1750
60	Woods	B	220–440	1200
60	West.	CS	220–440	690

AC SLIP RINGS

112	G. E.	ITC 5015	220–440	495
75	A. C.	ARY	220–440	1750
60	G. E.	MT 343	220–440	1200
50	G. E.	MT 343	220–440	1200
50	G. E.	MT 336	220–440	1200
50	West.	CI 654D	220–440	690
40	Howell	SR 504	220–440	900
40	Howell	SR 504	220–440	900

SYN MOTOR

75	West.	G	440	720 Dir. Con. Exc.
50	G. E.	TS7558	440	1200 Dir. Con. Exc.
40	G. E.	TS7542	440	900 Dir. Con. Exc.

DIESEL GENERATOR SETS

200 KW Ideal 240 3–60 327

VENN-SEVERIN Model M Engine

125 KW Ideal 240 3–60 327

TRANSFORMERS

3—1000 KVA	G. E.	13,800	6900 1 ph. 60 cy	
5— 100 KVA	Mol.	220 volt	11–11–12–14 16–18–20	
1—75 KVA	G. E.	13,200	120–240 1 phase	
2—50 KVA	G. E.	12,000	120–240 1 phase	
1—50 KVA	West.	7,200	120–240 1 phase	
6—25 KVA	G. E.	440–110	1 phase Dry Type	
1—37½ KVA	Penn.	1,200	120–240 1 phase	
1—37½ KVA	West.	7,200	240–120	
1—37½ KVA	West.	6,900	115–230	
10— 5 KVA	West.	13,800	115–230	

1000

3 KW, 3 Phase, 120 volt, AC Hobart Gas Engine Generator Sets. Skid Mounted. Panel and Starter. Outside inclosure. NEW

BEHR & SONS INC

1246 SEMINARY STREET
ROCKFORD, ILLINOIS

Check with WAGNER FIRST!

✓ Complete Stock A.C. & D.C. Motors and Generators

✓ New and "Certified Rebuilt"—UP to 1000 H. P.

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse syn cond		4000/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis Ch.	1 brg.	480	400
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec	ATB	2300	900
150	Whse.		2300/480	600
125	El. Machy.	Syn.	240/480	1800
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
90	Gen. Elec.	ATI	240/480	1200
75	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200
25	Whse. b.b.	1 phase	120/240	900

LOW VOLTAGE M-G SETS—2
Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	350	1200
250	Gen. Elec.	MPC	250	600
200	Gen. Elec.	RC	250	1150
150	Gen. Elec. b.b.	CDM	250	1500
105	Century b.b.	1500 amp.	70	1200
100	Allis. Ch.	E	125	1200
100	Allis Ch. (2)	E182	250	900
75	G. E. b.b. (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Cont. b.b.	D109X	125	1200
75	Whse.	SK160	250	1200
75	Columbia b.b.		120/240	1450
60	Allis. Ch.	E147	250	900
60	Whse. b.b. (2)	SK121	300	1200
50	Reliance	T	250	1150
50	Allis. Ch.	EW	125/250	1200
40	Gen. Elec.	CD103	250	1500
40	F. Morse b.b.	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

ADJUSTO-SPEED MOTOR
60 HP Louis Allis type OX-504Y b.b. 3/60/220/440 V. 400/1700 RPM with brake.

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
250	Gen. Elec.	LDR	250	450/850
200	G. E. (2)	RC59	230	850
150	Whse.	SK-201	230	300/900
100	Allis. Ch.	E182	230	600/1200
75	F. Morse b.b.	DH140	115	1600
75	Whse.	SK160	230	850
75	Whse.	SK170	230	635
60/75	Gen. Elec.	C	230	500/1200
50	Reliance	310T	230	850
50	Whse.	SK150	230	750
50	Reliance b.b.	651T	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Cr.Wh. b.b.	FH	230	1750
50	Whse.	SK183	230	300/900
40	Reliance	651T	230	350/1000
40	Allis. Ch.	E-121	230	1750
40	Gen. Elec.(2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD105	230	575/1720
20	Century b.b.	DN330	230	3500
20	G. E. series	CO-1826	230	875
20	Whse b.b.(2)	SK97	550	900

FREE!

New WAGNER MOTOR-GRAM lists hundreds of bargains in new and rebuilt Electric Motors and Generators. Write today!

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	G. E.	Slipring	2300	400
750	Whse.	Synch.	2200/4000	900
700	G. E.	Synch.	2200	514
600	G. E.	Synch.	220/440	257
600	E. M.	Synch.	480	1200
600	G. E. (2)	Synch.	2200/440	360
550	G. E.	Sq. Cage	2200	3600
500	Allis. Ch.	Slipring	2300	514
500	G. E.	Slipring	2200/440	450
500	G. E.	Sq. Cage	6600/4000	1800
500	G. E.	Synch.	440	900
450	Allis. Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis. Ch.	Sq. Cage	2200/440	1200
350	Whse. (2)	Slipring	2300	450
350	G. E.	Slipring	2200/440	600
300	El. Mach.	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G. E.	Slipring	440	360
250	G. E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Wagner TEFC	Sq. Cage	2200/440	1200
200	Whse. Ex. Pf.	Sq. Cage	2200/440	1200
200	Allis. Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slipring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Slipring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	G. E.	Sq. Cage	220/440	1200
200	E. M.	Synch.	220/440	514
175	Whse.	Synch.	220/440	360
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E.	Synch.	220/440	450
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Slipring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	E. M. (2)	Synch.	220/440	1800
125	G. E.	Slipring	2200/440	720

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	G. E.*	440 AC	250 DC
300	Allis. Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
250	Allis. Ch.	2200/440 AC	350 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G. E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
175	G. E.	2200/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Al. Ch.	220/440 AC	125 DC
100	Delco b.b.	220/440 AC	125/250 DC
80	Star* b.b.	220/440 AC	240 DC
75	Cont. b.b.	220/440 AC	125 DC
60	Gen. Elec.*	220/440 AC	60 DC
60	Whse. (2)	220/440 AC	300 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Allis Ch.	220/440 AC	125/250 DC
50	Cr.Wh.b.b.(2)	220/440 AC	240 DC
40	G. E. (2)	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	600 DC
30	Whse.	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
20	Star b.b.	220/440 AC	120 DC
16	Gen. Elec.	220/440 AC	125 DC
15	El. Frod.	220/440 AC	40 DC

*Synch. motor.

THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK

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TELEPHONE MOnroe 6-7409

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SCHOONMAKER DEPENDABLE DIESEL POWER

because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all RE-MANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

America's largest source of New and Remanufactured Diesel Power

A.G.

SCHOONMAKER CO., INC.

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JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA
TELEPHONE — DIGBY 9-4350 • TELETYPE — NY 1-2804
W. U. WIRE • CABLE — AGSCOMACH

PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
600	General Motors	12-567	900	600
*500	General Motors	8-278A	750	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*480	Worthington	DD-8	700	360
*400	Ingersoll-Rand	S-8	600	720
*400	Sterling	VDS-8	600	1200
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
150	Fairbanks Morse	338-17	225	300
*150	Worthington	CC-4	225	450
150	Ingersoll-Rand	S	255	600
100	General Motors	3-268A	150	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED
•—indicates NEW unit.

ONE YEAR GUARANTEE!

ELECTRICAL EQUIPMENT
REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.
500(3)	1800	West.	Syn. 2200 V.	PedBrgW/Exc
450	1800	AC	SC 2200 V.	AW-SB
350	1800	AC	SC 2200 V.	AW-SB
300	1800	West.	SC	CS-TEFC Exp. Pr.
150(2)	900	GE	SC 2200V	KF-558
150	1200	GE	SR	M-632a TEFC
150	720	Allis-Chal.	SR	AR Hoist
150	750	GE	SR (25 cy)	IM
125	1200	AC	SR	ARY-BB
125(3)	900	West.	SC 2200V	CS-856-C
100	720	West.	SR	CW-513
100	900	GE	SR	MT-SB
100	700	West.	SC	CS-SSB
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.
100	900	GE	Syn 2200 V.	TS-DC Exciter
75	1200	GE	SC	K-TEFC BB
75	900	West.	SR	CW-752C
75	600	GE	SR	IM
75	600	GE	SC 2200 V.	KT-558
60	1200	West.	SC	CS505 Spl. Pr.
60(3)	1200	Allis-Chal.	SR	ARY-505 BB
50	1800	FM	SR	HY-BB
50	1200	GE	SR	MT-336
50	720	CW	SC	SC
50	600	CW	SR	SR
40	3600	GE	SC	K-405aExp.Pr.
40(2)	1200	Rel.&West.	SC	Fr. 445-RB
40(2)	1200	AC&Rel.	SC	TEFC-BB
40	900	West.	SR	CW
40	720	AC	SR	ANY
30(3)	1800	AC	SC	ARZ-TEFC
30	1200	AC	SC	ARZ-TEFC

SPECIALS

2—333 KVA Penn. Transformers OISC 1/60—13800/2300.
1—500 KVA Trans. West'hse Type ASL. 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

NATIONAL ELECTRIC SERVICE CO.

321 Lombard St., St. Louis 2, Mo. Phone — Chestnut 4803

DIRECT CURRENT GENERATORS

5—1200 KW 500 Volt 720 RPM
2— 750 KW 500 Volt 1200 RPM
3— 600 KW 240 Volt 700 RPM
3— 600 KW 240 Volt 360 RPM
2— 500 KW 240 Volt 1200 RPM
2— 300 KW 240 Volt 650 RPM
1— 290 KW 240 Volt 1200 RPM
2— 250 KW 120 Volt 600 RPM
1— 150 KW 240 Volt 1200 RPM

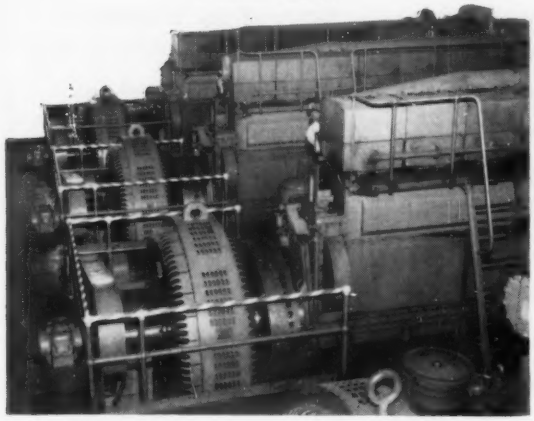
SUNDFELT EQUIP. CO., INC.
220 Hudson St. Seattle 4, Wash.
LAnder 9311

Special Offering

4240 KW DIESEL GENERATOR PLANT

HEAVY DUTY • SLOW SPEED • MODERN DESIGN

(ACTUAL PHOTO)



WORTHINGTON MODEL SEH-8 DIESEL UNITS

LATEST TYPE—CURRENT MODEL PRACTICALLY NEW

CAN BE INSPECTED AND TEST RUN . . . CONVERTIBLE FOR DUAL-FUEL OPERATION . . . WILL BURN HEAVY FUELS . . . ONE YEAR GUARANTEE

3—1180 KW WORTHINGTON MODEL SEH-8 DIESEL UNITS

ENGINES: Each rated 1685 BHP at 360 RPM turbocharged having 8 cylinders arranged vertically in-line, 16" bore, 20" stroke, 4 cycle, solid injection.

GENERATORS: Westinghouse each rated 1180 KW, 1475 KVA for 2400/4160 or 480 Volts, 3 phase, 60 cycle service.

SWITCHGEAR: Metal-clad type manufactured by Westinghouse with draw-out type air circuit breaker.

50 CYCLE RATING 984 KW AT 300 RPM

UNIT AUXILIARIES: Each unit complete with filters, strainers, pumps, gauge board, pyrometer, thermocouples, lube oil cooler, jacket water cooler, cooling tower, exhaust muffler, intake filter silencer, expansion tank, fuel day tank, flexible piping for intake and exhaust and all station piping, flanges, valves, gauges and fittings for intake, exhaust, water, lube oil and fuel oil systems.

ALSO

1—700 KW Worthington diesel unit with same auxiliaries and accessories as above.

This equipment affords you a rare opportunity to procure complete, modern, latest design diesel units at substantial savings. It represents an offering of heavy duty slow speed diesels which cannot be duplicated by anyone in the diesel field.

ACT TODAY—PHONE, WIRE, OR WRITE FOR FULL DETAILS

Other Modern Diesel Sets from 2000 KW to 15 KW in STOCK—All Owned and Offered Exclusively by "America's Largest Source of New and Remanufactured Diesel Power"

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

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PLANTS AT EDDYSTONE, PA., JERSEY CITY, N. J., SAUSALITO (S.F.), CAL.

RENTAL OR SALE
EXISTING
BOILERS
10 TO 5000 HP — 10 TO 900 PSI
EXISTING
DIESEL ENGINES — STEAM TURBINE
GENERATORS
5 TO 20,000 KW
STRICKLER ENGINEERING CORPORATION
5220 Pennington Ave., Baltimore 26, Md.
Curtis 7-2772

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

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TRY US with your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

FOR SALE—THREE COAL PULVERIZERS

These three Babcock and Wilcox type E-56, Class 111-BA coal pulverizers were bought new, have never been used, and are in good condition. They are complete with their primary air fans, motors, controllers, and other auxiliary apparatus. For detailed information write Purchasing Department.

PO BOX 570, SAVANNAH, GEORGIA

Your Portable Generator Headquarters

- DIESEL - - GASOLINE -

1 to 1000 KW, AC & DC

RENTAL • SALES • PURCHASES

Midwest Utilities Power Equipment Corp.
1270 W. Augusta Blvd. Chicago 22, Illinois
Everglade 4-4511

MOTORS • GENERATORS • TRANSFORMERS

3 PHASE 60 CYCLE 220/440 VOLT

HP	Make	Type	Speed
10	F.-M., 2 Speed	H-12B	600/1200
10	G. E.	KT-502	860
10	Cr. Wh., BB	SC-ALH 365	865
10	Allis Ch.	AR	1200
10	G. E.	KT-300	1200
10	G. E.	K-326	1200
15	West., New, Vert., BB	CW-404	900
15	G. E.	IK	700
15	G. E.	KT-312	900
15	G. E.	K-512	900
15	Cr. Wh.	SC	900
15	U. S., BB	FRB-482	1200
15	Reliance	IH	1200
15	G. E.	K-326	1800
15	L. Allis, TEFCCB, Ex. Pr.	EX-364	1760
15	G. E., Special	KF	3460
15	G. E., Var. Speed	IK	1800-600
20	West.	MS	900
20	G. E.	I	900
20	Wagner	BP-18T	1140
20	West.	CS	1150
20	West., New, BB	CS-365	1170
20	L. Allis, TEFCBB, Ex. Pr.	ES-365	1800
25	G. E., Slip Ring	I-M	685
25	G. E., New	K-405	900
25	G. E.	IK	1200
25	Allis Ch.	AR	3600
30	Wagner, Slip Ring		1200
30	G. E., Slip Ring	MT-523	1800
35	West., Slip Ring	CW-765	585
40	Cr. Wh.	1210	685
40	Lincoln	IM	720
40	West.	CS	1150
50	West.	CS	900
50	G. E.	K-504	1200
50	F. Morse	12-B	1725
50	F. Morse	N	1750
50	Ideal, New, TEFCCB	A-B	1800
60	West., TEFCBB, Ex. Pr.	CS-607	875
75	West., Slip Ring	CW	900
75	G. E.	KT-356	865
75	F. Weischel, Synch.	26Y-RN	1200
100	West., Slip Ring	CW	435
150	G. E.	KT-5585	875
200	G. E., Slip Ring	IM	600
200	G. E., Synch.	2300 volt	225
350	G. E., Synch.	4800 volt	225

25 CYCLE MOTOR SPECIALS

1— 40 HP Reliance TEFC BB 3/25/220/440/1500 RPM.

1— 50 HP Fairbanks Morse BB 3/25/220/440/750 RPM.

1—100 HP Gen. Elect. Type KT 553 3/25/440/1445 RPM.

1—100 HP Gen Elect. Type KT 5595 Ball Bearing 3/25/440/1465 RPM.

2—150 HP Gen. Elect. Type KT565 TEFC BB—3/25/440/750 RPM.

MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

400 HP GEAR REDUCER

1—400 HP Nutall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 H.P. COMPENSATOR

400 H.P. Westinghouse reduced voltage, manually operated synchronous motor starter—Unity P.F.—3/65/2300 Volts—Complete.

55" LIFTING MAGNET

1—55" Cutler Hammer Magnet 250 Volts DC. Excellent Condition.

125 VOLT DC MOTOR

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole
1—1600 AMP. Condit. 2 Pole
1—1600 AMP. Westinghouse 2 Pole
1—3000 AMP. Westinghouse 2 Pole

TRANSFORMERS

1—750 KVA Niagara, New. Outdoor 3/60/2400/208Y/120

1—300 KVA Niagara, New. Non-inflammable Liquid. 3 Phase, 60 Cycle 4160 V. Prim. 480 V. Secondary, Primary Fused Cutouts, Secondary Junction Box. Immediate Shipment

1—75 KVA G.E. Dry Type 1/60/440 V. Primary 220 V. Secondary

6—50 KVA Niagara. New. Dry Type 1/60/240/480-120/240

1—20 KVA G.E. Dry Type. 1/60/480 V. Primary, 120 V. Secondary

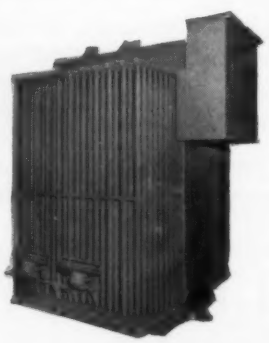
ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y.
CL. 4758

MOTORS

REBUILT — GUARANTEED

SQUIRREL CAGE

Qu.	HP	RPM	Make	Volts
2	150	1800	West. CS	440
1	150	3600	West. CS	2200
1	100	720	G.E. I-K	220/440
1	75	900	G.E. KT	440
1	75	900	G.E. I-M	2200
1	75	1200	G.E. MT	220
1	75	1800	West. CS505	440
2	75	1800	G.E. Ex. Pf.	2300
			NEMA	
1	60	1200	West. CS505	440
1	50	720	G.E. KT	2200
1	50	1800	Allis-Chalmers	2200
2	50	1800	Cent. Hi-torq.	220
1	50	1800	F-M	220
1	50	1800	West. CS-445	220/440
			SLIP RING	
1	800	600	Gen. Elect.	2200/440
1	360	350	Gen. Elect.	2300
2	200	1800	Gen. Elect.	440
1	150	720	West.	440
2	150	600	Gen. Elect.	2200/440
1	125	600	Gen. Elect.	440
1	100	900	Gen. Elect. MTC	440
2	75	720	West.	2200
1	75	1800	Gen. Elect.	2200
1	75	1800	West.	2200
1	60	900	Gen. Elect.	220



2500 KVA 3 Phase 60 Cycle
General Electric Pyranol Filled
11500 to 480 V — Indoor — Taps

OUTDOOR INSTRUMENT TRANSFORMERS

2—110000/66000-110 volts 200 VA West. P.T.
3—34500-115 volts 200 VA West. P.T.
9—33000-110 volts 200 VA G.E. P.T.
2—60/120—5 A. 37 KV G.E. C.T.

TRANSFORMERS

SAVE TIME

FAST SHIPMENT FROM STOCK

DISTRIBUTION TRANSFORMERS
1 Phase 60 Cycle

3—3333 KVA 66000 to 33000 & 13200 v.
2—1000 KVA 13200—2300 v.
3— 500 KVA 38100/66000Y—2300 v.
3— 500 KVA 33000—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000—2300/4160Y v.
5— 200 KVA 13200—2300/4160Y v.
1— 200 KVA 12000—2300/4160Y v.
3— 200 KVA 7620/13200Y—2300 v.
1— 150 KVA 66000—2300/4160Y v.
14— 100 KVA 33000—2300/4160Y v.
9— 100 KVA 13200—2300/4160Y v.
6— 100 KVA 7620/13200Y—2300/4160Y
3— 75 KVA 460—120/240 v.
3— 75 KVA 2400—230/460 v.
2— 50 KVA 60000—2300 v.
1— 50 KVA 6600/11400Y—2300 v.
3— 50 KVA 13200Y—2300 v.
1— 25 KVA 13200Y—240/480 v.
1— 25 KVA 7200/12470Y—240/480 v.
3— 25 KVA 400/4160Y—120/240 v.
3— 25 KVA 2400—230/460

8—15 KVA 67—5 KVA
62—10 KVA 26—3 KVA
71—7½ KVA 15—1½ KVA

WE WILL REWIND ANY OF THESE TRANSFORMERS OR MOTORS TO YOUR SPECIFICATIONS

TAMPA ARMATURE WORKS INC.

401 S.MORGAN ST. TAMPA, FLORIDA PHONE 2-1966

POWER EQUIPMENT

TURBINE UNITS

1—2500 KVA G. E. 3/60/600/2400 V. 3600 RPM STRAIGHT CONDENSING nozzled for 275 psig.
1—1250 KVA Al. Ch. 3/60/480 V. 3600 RPM, Terry EXTRACTION turbine nozzled 250 psig 550° TT
1—938 KVA West. 3/60/480 V. 3600 RPM Terry EXTRACTION turbine nozzled 250 psig. 500° TT 10,000# extr. 50 psig. Surf. Cond.
1—500 KVA West. 3/60/480 V. 1200 RPM Geared Moore turbine NON-CONDENSING 185 psig 20 psig BP 3965 RPM
1—375 KVA G. E. 3/60/480 V. 3600 RPM NON-CONDENSING 150 psig 5-10 psig BP

MOTOR GENERATOR SETS—60 CY.

QU.	KW	MFR.	V.—DC	A.C.	RPM
1	3000	G.E.	250	13200	514
1	1500	G.E.	600	3150	600
1	1000	West.	300	4600/2300	720
1	200	West.	275	2200	900
1	75	Ridgway	125	220	1200

SYNCHRONOUS MOTORS

QU.	HP	MFR.	VOLTAGE	RPM
2	2000	West.	13200	1200
2	700	West.	2300	200
1	600	G.E.	2300	240
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

QU.	KVA	MFR.	CYCLES	RPM
1	12500	G.E.	25/60	300
1	3750	G.E.	25/60	300
1	2500	G.E.	25/62½	750
1	1875	A.C.	60/25	300
1	1700	West.	60/24	720
1	500	G.E.	25/60	300

OIL CIRCUIT BREAKERS—Outdoor

4— 800 A. 132 KV West. G-222A-2500 MVA
1— 400 A. 73 KV Condit FO-40-250 MVA
2— 400 A. 37 KV G.E. FHKO-136-350 MVA
4— 600 A. 15 KV G.E. FHKO-139-750 MVA
1—1200 A. 15 KV G.E. FKO-139-350 MVA
7— 600 A. 15 KV G.E. FK-155-28-350 MVA I/D

TRANSFORMERS

4—	2500 KVA Mel.	69000—13800
4—	500 KVA West.	69000—6900
3—	400 KVA G.E.	69000/33000—2300/41600
3—	1250 KVA A.C.	44000/11500—460
4—	500 KVA G.E.	44000—7200
3—	150 KVA Mel.	44000—2400/7200
3—	75 KVA West.	44000—7200/12470 Y
4—	5000 KVA G.E.	40935/70900 Y—14500
3—	3333 KVA G.E.	33000/11000—2400/7200
3—	333 KVA G.E.	33000—7200/12470 Y
3—	200 KVA A.C.	33000—2400/7200/12470
4—	100 KVA A.C.	33000—7200
3—	75 KVA Wag.	33000—7200/12470 Y
3—	1250 KVA G.E.	26400/13200—2400
4—	1500 KVA A.C.	25400/44000—6900/13800
4—	450 KVA A.C.	25410/44000—13280/2300
3—	1000 KVA Mel.	22000—2300
3—	500 KVA G.E.	22000/3810C Y—240/480
3—	100 KVA G.E.	22000—7200/12470 Y
1—	3000 KVA Stand.	19050/33000—4160, 3 ph.
1—	600 KVA Stand.	13200—2300, 3 ph.
1—	450 KVA Penn.	13200—2400, 3 ph.
3—	200 KVA G.E.	13800—2300
3—	250 KVA Pitts.	7200—220/440
3—	150 KVA Wag.	6900—2300
3—	37½ KVA G.E.	6900—230/460
4—	150 KVA G.E.	4800/2400—240/120
3—	333 KVA G.E.	2300—230/460
3—	250 KVA G.E.	2300/4000 Y—115/230
3—	200 KVA West.	2400—240/480
3—	150 KVA West.	2400—230/115
1—	100 KVA G.E.	2300—575, 3 ph.
6—	50 KVA West.	2400—114/228, Dry Type

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BREW, WOLTMAN & CO., INC.
50 Church St. New York 7, N. Y.

FLUID DRIVE · GYROL TYPE VS
● HYDRAULIC COUPLINGS ●

Stepless speed variation with constant speed prime mover made by American Blower Co. Ideal for pumping stations, steel mill drives, mechanical draft fans, crushers, rotary kilns, etc.
Wide range of capacities—Condition 98% new
200 HP to 2500 HP Input
300 RPM to 900 RPM Input
Complete data & quotation on request.
Also large selection of marine couplings, reduction gear, & Falk grid type couplings in stock.

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THE TRADE MARK WITH A MEANING SUCCESSFUL OPERATION GUARANTEED

45th Year of Service—Member of A.R.A. and N.I.S.A.

A. C. MOTORS

3 ph. 60 Cycle

SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1—	4350	Cr. Wh.		4160/13800	514
2—	3500	G. E.	TS	2300	257
1—	2500	G. E.	ATI	2300	720
2—	2100	G. E.	ATI	2300	360
2—	2000	Whse.		2300	120
1—	2000	G. E.	ATI	2200	900
2—	1750	G. E.	ATI	2300	3600
3—	735	G. E.	ATI	2200/12000	600
1—	720	G. E.	TS	2200	720
1—	500	Ideal	SM	2300/4150	1800
1—	450	Whse.	Eng.	2200	128.5
1—	450	Whse.		2300	450
1—	400	G. E.	TS-6424	2200	400
2—	350	G. E.	TS	2200	150
1—	300	Whse.		2300	720
1—	150	Whse.		440	600

SLIP RING

1—1500	G. E.	MT-498	2300	360
1—1500	ABB		2300	720
1—1200	G. E.	MT-26	2300	275
2—1000	A. C.	Mill	2300	240
1—1000	G. E.	MT-452	2200	321
1— 500	Whse.	CW	550	360
1— 500	G. E.	M-574Y	2200	900
1— 450	G. E.	IM	440	720
1— 400	Whse.	CW-1218	2200	435
1— 400	Whse.	CW	440	514
1— 400	Whse.	CW-960A	440	1170
1— 350	G. E.	MT-442	2300/4000	253
1— 350	G. E.	IM-17A	440/2300	720
1— 250	G. E.	MT-424Y	4000	250
1— 250	G. E.	MT-559S	2200	1750
1— 250	A. C.		550	600
1— 200	Cr. Wh.	26QB	440	505
1— 200	G. E.	IM	440	435
1— 200	G. E.	MTP	440	1170
1— 150 new	Whse.	CW	2300	450
1— 150	G. E.	IM-16	440	600
2— 125	A. C.		440	865
1— 125	A. C.		440	720
4— 125	G. E.	MT-566Y	440/2200	435
2— 100	G. E.	IM	440	600
1— 100	G. E.	IM	2200	435
4— 100	A. C.		440	695
4— 100	G. E.	MT	440/2200	435

SQUIRREL CAGE

2— 650	G. E.	FT559BY	440	3750
2— 450	Whse.	CS	2300/4150	354
1— 300	Whse.	CS	440	1170
1— 200	G. E.	IK-17	440	580
3— 200	G. E.	KT-557	440	1800
1— 75/150	G. E.	IK	440	450/900
1— 150	Whse.	CS	440	550
1— 150	Westghse.	CS856S	440	880
1— 125	Whse.	MS	440	485
2— 125	Al. Ch.	ARW	2200	1750
2— 100	G. E.	IK	440	580
1— 100	Whse.	CS-TEFC	208	720

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1—	2200	G. E.	MCF	600	360/500
1—	2000	Whse.	Mill	600	230/460
1—	940	Whse.	QM R Brg.	250	140/170
1—	900	Whse.		250	450/550
1—	825	Whse.	Mill	250	90/180
1—	600	A. Ch.	Mill	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G. E.	MCF	550	300/1050
1—	300/400	G. E.	DYNA	250	1325/2500
1—	300	Whse.	CB-5094	230	575/1150
1—	200/300	G. E.	MPC	230	360/920
1—	250	G. E.	MPC	230	400/500
1—	200	Rel.	1970T	230	720
1—	200	Whse.	CB-5113	230	400/800
1—	150	G. E.		600	250/750
6—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
1—	140	Whse.	SK-151 B	230	900/1800
1—	125(new)	Whse.	SK-183	230	850
1—	125	G. E.	MDB-416	230	415
1—	75	C. W.	53H-TEFC	230	860
1—	75	Whse.	SK-170	230	600/1200
2—	50/120	G. E.	MFC	230	250/1000
2—	100	Whse.	SK-181	230	450/1000
1—	60	Rl. Dy.	75-S	230	525/1050
2—	50/60	Whse.	SK-170	230	400/1200
1—	50	G. E.	CO-1810	230	725
1—	50	Whse.	SK-170	230	350/1050
1—	50	G. E.	RCF-81B	230	1700
2—	40/50	G. E.	CD-135	230	300/1200

MOTOR GENERATOR SET

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	3000 (3U)	G. E.	514	600	4000/13200
	2000	G. E.	514	600	13800/4000
2	2000	G. E.	450	250	2400
1	2000(25 cy)	G. E.	500	650	6600/11000
2	1750	G. E.	514	250	2400
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514	115	4160/13800
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	6600
1	1000(3U	G. E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	750	C. W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	900	125/250	440
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	150	Whse.	1200	600	2200
1	150	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G.E.	1175	125	440
1	140(3U)	Cr. Wh.	690	125-250	2 300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
1	100	G. E.	1200	250	2300/4000

12,500 KW 60 to 25 CYCLE FREQUENCY CHANGER—IMMEDIATE SHIPMENT

Westinghouse 300 R.P.M. 4 Bearing frequency changer set. Motor 17200 H.P. .7 P.F. 13200 Volt. 3 ph., 60 cy. Generator 13900 K.V.A., 12500 KW .9 P.F. 13200 volt, 3 phase, 25 cycles, with 2 direct connected 125 volt exciters, complete including motor operated phase shifter, air washer; 60 and 25 cycle controls—Prints, performance guarantees and complete details available—Can be inspected in operation.

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	3000	G. E.	25/60	4000/2300x2300/4000
1—	2000	G. E.	25/60	2400x4150
1—	2000	G. E.	25/62½	2300/4160
1—	2000	Whse.	25/62½	2300/2300
1—	1000	G. E.	25/58	4400/2300
1—	500	A. C.	25/60	11000/2300V

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G. E.	Condensing 425 — 750°F.T.T Surface Condenser 3/60/2300/4000V Direct conn exciter
1	1000	Moore	Auto - Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G. E.	Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944
1	750	Whse.	—Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.
1	500	Moore	Non-condensing—150/200 lbs. I.S.P. 5/35 lbs. G.B.P.—3/ 0/ 480 volts direct connected exciter.
2	500	G. E.	Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/6
1	300	G. E.	Non-condensing 10/175# I. P. 5/15# B.P. 480V. 3 ph. 60 cy

TRANSFORMERS

60 Cycles

Qu.	KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	3300x26400/13200
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66000x13800
3	1000	G. E.	H	1	2200x480
1	1500	G. E.	HT	3	13200x2300
1	1500	G.E.Pyranol	Auto	3	440 x4000
3	1250	G. E.	H	1	6600x550
1	1000	Pitts	OISC	3	26400/13200x2400
2	1000	Pitts.	OISC	3	2300x460
4	1000	Al. Ch.	OISC	1	2300/4000x460
3	1000	Wagner	OISC	1	13200x220/440
1	300	Kuhl	OISC	3	13800x460
3	200	Whse.	OISC	1	13200x120/240
3	150	Whse.	OISC	1	33000x2300/4000
3	150	G. E.	HKR	1	13200x2300/4000
3	100	Whse.	S	1	480/120/240

BELYEA COMPANY, INC.

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THE CLOSER YOU LOOK
THE MORE YOU'LL BE SATISFIED
WITH THE QUALITY AND ECONOMY OF

HEMPHILL *Guaranteed* EQUIPMENT

DIESEL GENERATOR SETS

3—75K2A C.W., 120/208 V., 3 Ph., 1200 RPM. V Belt. to KRUPP. 3C1/L., 2 cy. solid injection complete.

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1000	G. E.	Auto	3	4150x2400
2	750	G. E.	HT	3	4150x120/240
2	750	G. E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G. E.	H	1	13200x220/440
2	300	G. E.	H	1	13200x440
4	200	G. E.	H	1	13200x440
1	200	G. E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	50	G. E.	H	1	4800x120/240
3	50	A. C.	H	1	230x120/240
1	25	G. E.	H	1	460x120/240

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
2	500	G. E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G. E.	600	MT	440
3	150	A. C.	1800	AY RW	2300
1	100	G. E.	1800	IM	220
1	100	G. E.	600	IM	440
1	75	G. E.	600	IM	440
1	60	G. E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G. E.	1200	MPC
2	150	C. W.	900	WP
1	125	G. E.	1700	RC
2	75	C. W.	900	WP
1	50	C. W.	700	CM
1	35	G. E.	860	RC
1	25	Whse.	835	SK

WESTINGHOUSE M.G. SET

1000 KW, 600V D.C., 2400/4160V, 720 RPM, 3 Ph., 60 Cy., .7 PF Syn. Motor. Direct Connected Exciter, Motor Driven Rheostats, Switch Boards, all for full automatic operation.

SQUIRREL CAGE MOTORS

Qu.	Make	Speed	Type	Volts
150	G. E.	720	KT	440
125	G. E.	3560	KF	2300
100	G. E.	1200	FTR	220
75	Ideal	1200	AT	220/440
60	G. E.	1200	KT	220
50	G. E.	3560	FT	220
50	G. E.	600	KT	440
40	G. E.	3550	FT	440
30	G. E.	600	KT	440

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G. E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C. W.	1200	230	3-unit 2400/41508R
1	300	G. E.	1200	230	2400/41503R
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C. W.	1200	230	440 SC
1	150	3 Unit G. E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C. W.	1200	125	2300 S.C.
1	100	G. E.	900	250	2300 Syn.
3	60	G. E.	1200	125	208 Syn.
2	30	G. E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G. E.	720	ATI	2300
1	150	G. E.	720	ATI	2300
1	150	G. E.	1800	TS	220
1	150	Whse.	900	ISIG	220

OIL CIRCUIT BREAKERS

3—600 AMP. G. E. FKR-55-20, 15,000 V. 3 P. 100,000 KVA, SOLENOID OPER.

1—600 AMP. G. E. FK-143, 15,000 V. 3 P. 50,000 KVA, Manual with Disconnects, Metal Clad Enclosure.

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MOTORS — GENERATORS — TRANSFORMERS
MOTOR GENERATOR SETS — CONTROLS —
COMPLETE VARIABLE VOLTAGE DRIVES

30 YEARS (1924-54)
SERVING INDUSTRY

BUY FROM ONE OF AMERICA'S LARGEST STOCKS

SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle

Qu.	H.P.	Make	Type	Volts	R.P.M.
1	400	Cont.	NZ-606-S	2300	1200
1	400	G. E.	I-K	2200	514
1	300	Whse.	CS-890	2300	1750
1	200	Whse.	CS-873-C	2200	1160
1	200	Al. Ch.	AR	440/220	580
2	125	Al. Ch.	AR	2300	1750
1	125	Al. Ch.	AR	2300	490
1	100	Whse.	CS-663-C	440	1750
1	100	G. E.	KT-342	440/220	570
1	100	Whse.	CS-933	2200	495
1	100	F. M.	H-241B	440	435

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	V. DC	V. AC
1(3U)	2100	Whse.	720	600	4800/2400
2	1100	Whse.	720	600	2300
3	1000	Whse.	514	600	11000/6600
3	500	C. W.	720	575	2300
1	400	C. W.	720	250	2300
1	400	C. W.	1200	125/250	440/2300
1	300	Whse.	1200	275	2300
1	200	Whse.	1200	275	4000/2300
1	200	Whse.	1200	600	4000/2300
2	150	Whse.	1200	250	440
1	155	G. E.	720	250	2300/440
1	100	Ridgeway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	85	C. W.	1200	250	4000/2200
1	75	Al. Ch.	900	250	2300
1	25	Ideal	1750	125	440/220
2	25	Al. Ch.	1200	250	440/220
3	20	Al. Ch.	1200	250	440/220

Any of these sets can be furnished with D.C. panels and starting equipment.

SLIP RING MOTORS
Constant Duty, 3 Phase, 60 Cycle Type

Qu.	H.P.	Make	Type	Volts	R.P.M.
1**	1800	G. E.	MT-498	2300	357
1**	1200	G. E.	MT-26	2200	277
2	800	G. E.	MT	2200	440
1	700	G. E.	I-M	2300	400
1**	600	G. E.	MT-20	2300	360
1**	500	Al. Ch.	ANY	2200	514
2	500	G. E.	I-16-M	2300	450
2	400	G. E.	MT-412	2200	450
1	250	Whse.	CW-937	440	1200
1	250	G. E.	MT-414	2200	300
1	250	Al. Ch.	ARY	440	720
2	100	G. E.	I-15-M	2300	514

**—Pedestal bearing design.

SYNCHRONOUS MOTORS
3 Phase, 60 Cycle

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	4350	C. W.	80	13200/6600	514
1	3000	Whse.	80	4800/2400	720
2	2100	G. E.	100	2300	360
2	2000	G. E.	80	2300	720
2	1750	G. E.	100	2200	3600
1	750	G. E.	80	2300	450
1	710	G. E.	80	2300	720
2	600	G. E.	80	2300	600
1	250	G. E.	100	2300	514
2	200	Whse.	80	440	1200
1	187	G. E.	80	440	720
1	150	G. E.	100	2200	900
1	150	G. E.	100	550	600
1	150	Whse.	80	440/220	450
2	135	G. E.	80	4000/2200	1200
3	125	El. Mchy.	100	4800/2400	900
1	125	G. E.	8	2200	900
2	100	Whse.	8	440	1800
1	100	Ideal	8	440/220	900
3	100	G. E.	8	440/220	600

We have a large stock of manual magnetic and semi-magnetic, reduced and full voltage control for use with these motors.

SAVE $$$$ ON YOUR PURCHASES

DIRECT CURRENT MOTORS
(230-VDC)

Qu.	H.P.	Make	Type	R.P.M.
6*	3000	Whse.	Mill	600
14*	1500	Whse.	Mill	600
10*	800	Whse.	Mill	600
8	700	Whse.	Mill	350/700
1	350	G. E.	CD-169	1150
1	250	G. E.	MPC	325/975
1	200/250	G. E.	MPC	300/900
1	200/250	El. Dy.	Size 22	400/1200
1	200	Whse.	Mill	300/1200
1	180	G. E.	MPC	400
1	160/90	G. E.	MPC	625/1125
1*	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
6	100	El. Dy.	30-S	450/1100
5	T.E.F.C. 75	C. W.	H-53	860
1	50	Whse.	SK	250/1000
1	40	Whse.	SK-140	500/1700
1	35	G. E.	CD-125	400/1200
1	35	G. E.	CD-147	300/1200

SAVE 50% — Immediate Shipment — REBUILT — GUARANTEED 4500 K.V.A. Gen'l Elec. Transformer 3 ph., 60 cy., Serial 6800048 27000/13500 (4-2½% taps)—2300 V., expansion tank, external tube radiator oil cooling.

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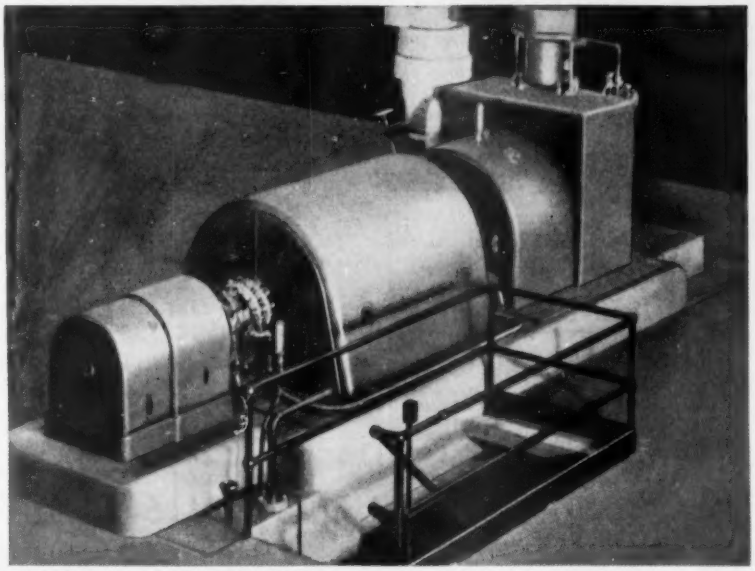

A REBUILT G.E. TURBINE SET

TURBINE SETS: 500-KW., to 2500-KW., UNITS, Non-condensing, Now in Stock: Immediate Deliveries.
ALSO 2 B & W BOILERS, New, Never Erected, 150,000 lbs. Steam pr. hr. 350# psig., 750° F. TT., 2-Drums. Many Other High Grade Boilers.

ALL PRICED FOR QUICK SALES. SEND US MEMO. OF ANYTHING NEEDED FOR YOUR POWER PLANT

IN STOCK ALSO: CONDENSING TURBINE SETS 300-KW. to 12,000-KW., ALL HIGH GRADE UNITS: ALSO FULL LINE OF DIESEL POWER

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CHARLES WEAVER
4145 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

TELEPHONE: WO. 1-1340-1

MOTORS · MG SETS

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
26	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
2	800	West.	525/600/600/900	RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G.E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

All motors designed for mill reversing service.

Smaller sizes also in stock.

Motor Generator Sets in Stock
100—2000 KW Capacity

All of above is modern late type equipment remanufactured & tested by our engineers.

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Plants: SAUSALITO (S.F.) CAL., JERSEY CITY, N. J.

M-G SETS! MOTORS!

1—500 KW, 240 V. D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200, Ser. 4979926 with magnetic reduced voltage starter.

1—200 KW, 125 V. D.C., Type PED, Ser. 576881, E-M Set, 900 RPM. Syn. drive, 3/60/2300 (or 4160).

TURBO-GENERATOR

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/480. Elliott Turbine, inlet 200% ga., 112 deg. F superheat, 28" hg. vac. exhaust. Complete with accessories.

SQUIRREL CAGE MOTORS

Amt.	HP.	Speed	Make	Type	Frame
1	250	1200	Elliott—BB	Splash	2810
3	250	600	G. E.	KT568	
1	150	1800	A-C		
1	150	900	G. E.	I-K (2200V.)	15
1	100	1800	Whse.	CS	663C
1	100	1200	L.A. XP-1D	EX	108
1	100	900	G. E.	MT356	Slpr.

NEW MOTOR STARTERS

3—Size 3, A-B, XP-2G Label Bul. 709

1—Size 3, Whse. Combination, circuit breaker, Nema 1, 3/60/440

21—Size 2, G.E. Combination fusible, 60 and 100 amp, 3/60/220

88—Size 1 Whse. life line, 3/60/220

1—250 HP, G.E. manual compensator, 3/60/440 CR1034-K33

7—60 thru 200 HP EC&M, 3/60/2300 Size 10 Magnetic Compensators

GEARMOTORS

1—20 HP, 400 RPM, Westinghouse ID-XP

1—15 HP, 100 RPM, G.E. tri-clad, Fr. 365

3—10 HP, 55 RPM, Whse. Fr. 324, parallel shaft output

1—7½ HP, 11 RPM, Whse. Fr. 284Y, TEFC

18—Cleveland right angle worm gear reducers, rated 5 HP-1150 RPM, 7.5 HP-1750 RPM, 6-1 ratio, Series 215, Size 50 RT, Class 1

4—Ratio 10-1, Series 25F—ditto

NEW INGERSOLL-RAND MOTOR PUMPS

Amt.	GPM.	HD.	Type	Motor Encl.
2	140	90	2-ORVL-7½	TEFC
2	134	90	2-ORVH-5	XP-1-D
1	1500	35	5-KVL-25	XP-1-D
1	1½ x 1½		88L	XP-1-D

OISC-TRANSFORMERS—Single Phase

Amt.	KVA.	Make	Type	Volts
9	37½	G.E., Moloney, Whse.		2400–240/480
2	50	Wagner	HEX	4000–1328/2300Y
3	75	Whse.	S	2400/4160–480/240
3	150	Moloney	HE	4000–230/460

PARTIAL LISTINGS—10,000 OTHER MOTORS IN STOCK—SLIPRING—SYNCHRONOUS. NEW MOTORS AT LONG DISCOUNTS.

BENSON-WILIMZIG, INC.

1708 North 8th St. Phone—Garfield 4290 St. Louis 6, Missouri

BOILER

1037 HP-700 lb. B & W Type IF Spreader Stoker.

Complete Accessories and Auxiliaries.

MERRILL and COMPANY
407 S. Dearborn St. Chicago 5, Ill.
Telephone HArrison 7-8289

GUARANTEED REBUILT POWER EQUIPMENT

M. G. SETS

K.W.	Make	A.C.	D.C.
1000 (3u)	Westgh.	11000	137/275
500	Westgh.	2300	137/275
500	Westgh.	2300	275
450 (3u)	G.E.	2300	125/250
400	A.C.	2300	120/240
300	G.E.	2300	250
200	G.E	2300	250
200	Westgh.	4160	250
200	G.E.	440	550
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	G.E.	4000	250
150	A.C.	2300	275
150	G.E	440	275
100	Westgh.	440	125
100	Elec. Mch.	440	125
100	Ridgeway	2200	275
100	G.E.	240	230
100	G.E.	440	125
75	G.E.	440	125
90	G.E.	440	60
60	Westgh.	2300	125
60	A.C.	2300	125
50	G.E.	240	250
50	Reliance	440	250
50	Westgh	240	125
40	G.E.	440	125
40	G.E.	440	250
35	Westgh.	2300	150
30	G.E.	440	250
30	Westgh.	2200	125

TRANSFORMERS

KVA	Make	Phase	Primary	Secondary
1000	West.	3	4800	480
850	West.	3	34160	455
667	G.E.(H) 1	3	34500	480
667	G. E.	1	3000	480
500	American	1	2400	240/480
400	G.E.(H)	1	2300	230/440
400	West. (air)	3	12000	213
300	G. E.	3	13800	240/480
300	G. E.	3	2400	240/480
250	G. E.	1	4160	240/480
200	Wagner	1	2400	575
167	A.C.	1	2400	120/240
100	Pittsburgh	1	2400	575
100	Pittsburgh	1	2400	240/480
100	American	1	2400	240/480
100	G. E. (Py'l)	1	2400	120/240
50	Westgh. (CSP)	1	7200	120/240
50	West.	1	2400	120/240

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Dry Type — Air Cooled
STANDARD or SPECIAL RATINGS
Made to your Specifications
Any Quantity — Quick Deliveries
Send us your Inquiries for Prompt Quotations

SLIP RING MOTORS

2 Phase, 60 cycle, 220 or 440 Volts (*2300 Volts or higher)

HP	Make	Type	Speed
2000	*G.E.	MT 12	600
1500	*G.E.	MT 30	240
1250	*Westgh.	CW	600
1000	*Westgh.	CW	250
800	Allis-Chal	ANY	600
700	*Al-Ch	ANY	720
600	*G.E.	MT 422	600
500	*Al-Ch	ANY	600
500	Westgh.	CW	350
400	Al-Ch	3-Brg	450
400	*G.E.	MT 412	450
300	*G.E.	IE-15A	1800
300	*G.E.	MT-410	450
250	Westgh.	HF-15H	600
200	*Westgh.	CW	1200
200	G.E.	IM	600

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 Volts (*2300 Volts or better)

HP	Make	Type	Speed
1750	*G.E.	K	3600
1500	*Westgh.	CS	1200
800	*G.E.	K	1800
800	*Westgh.	CS-1485	1800
700	*Westgh.	CS	1200
600	G.E.	FT-559	3600

SAVE 50 to 80% OVER NEW and get GUARANTEED PERFORMANCE

CHICAGO ELECTRIC
Carries Complete Stock of

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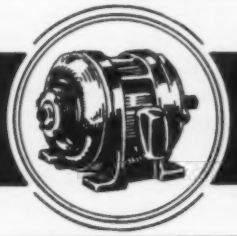
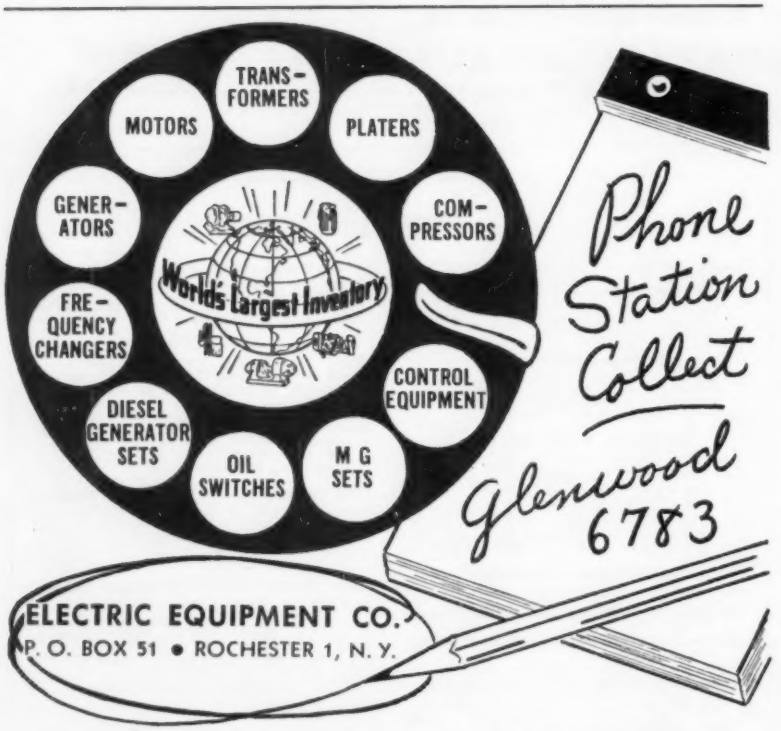
- D.C. MOTORS
- M.G. SETS
- GENERATORS
- TRANSFORMERS
- CONTROLS
- COMPRESSORS
- HOISTS • PUMPS
- SWITCHBOARDS

PHONE: CANAL 6-2900



CHICAGO *Electric Co.*

1320 WEST CERMAK ROAD, CHICAGO 8, ILL.



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TRANSFORMERS FOR SALE

6—	1000 KVA Mol	11500—2400/4160Y
6—	833 KVA G-E	35000—480
3—	333 KVA G-E	33000—2300/6900
3—	333 KVA G-E	33000—2300/4000Y
3—	333 KVA Mol	7200/12470Y—2400/4160Y
3—	333 KVA W-H	6600—2300
3—	200 KVA G-E	2400/4160Y—120/240
3—	150 KVA G-E	44000—600/2400
3—	150 KVA G-E	19050/33000Y—2540/4400Y
3—	100 KVA G-E	33000—6900/11950Y
3—	50 KVA A-Ch	33000—2400/4160Y
1—	450 KVA Penn	14520/13200—2400 3-ph.
1—	150 KVA G-E	7620/13200Y—120/208Y 3-ph.

Many other items in stock

TRANSFORMERS WANTED

Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
CINCINNATI 27, OHIO
40 Years Dependable Service

15,000 Lb. B&W WT Boiler—1945
80 HP 125# Erie City Boiler
60 & 35 HP 160# Vertical Boilers
D-13000 Cat. Diesel Elec. Sets (4)
1100 HP Boiler Plant WICKES 3-drum
500 HP 600# B&W WT Boiler—1946
7500 KW GE-Curtis Turbo Gen. Set
300 KW 220-3-60 Eng. Gen. Set
H. & P., 6719 Etzel, St. Louis 14, Mo.

O'Brien Offers—

MOTOR GENERATOR SETS

2—1500 KW Westinghouse 275 V D.C. 514 rpm with 3/60/13,200 V. Synch. Mtr. drive.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
Smaller Sizes and Types—Advise Requirements

DIESEL GENERATOR SETS

900 KVA GM 12-567 Diesel 3/60/2300
750 KVA GM 12-567, 3/60/2300
375 KVA GM 8-268 Diesel 3/60/440
300 KW GM 8-268 Diesel 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
125 KVA Waukesha Diesel 3/60/220-440
100 KW Buda Diesel 250 V. D.C.
100 KVA Murphy Diesel 3/60/220-440
65 KVA Buffalo Gas 3/60/220
56 KVA Climax Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
30 KVA LeRoi Gas 3/60/220
25 KVA LeRoi Gas 1/60/120/240
20 KW Hercules Gas 110 volt D.C.
18.75 KVA Hercules Diesel 1/60/120/240

BOILERS

1—300 HP Keeler CP 300 lb. Oil
1—250 HP Ames Package type (1948) 150 psi oil fired
1—250 HP B & W 250 lb. 1948
2—200 HP Springfield Sec. Hdr. 400 psi.
1—100 HP Clayton Pkg type 160 psi oil fired
1— 25 HP Dowtherm Vaporizer

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
3	3500	G.E.	IM	2300	120
1	350	G.E.	MT18	2300	400
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

TURBO GENERATORS

Philadelphia Stock

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 85 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

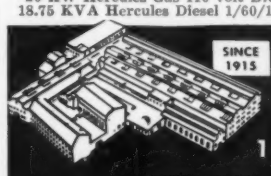
1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—973 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr Dr. 3/60/2300
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—216 CFM Penna 3A, 70 psi—V-Belt.
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—871 CFM Schramm 7⅛x6x4, 100 psi
1—173 CFM Chicago NSB 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
2	250	West. Dry	13800	230	1
3	150	West.	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single ph. 60 cyc.

"Everything from a Pulley to a Powerhouse"



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USED 35 TON BRIDGE CRANE

75' span with 5 ton aux, 25' lift. Cab type 3/60/220 V. A.C.—used approx. 2 yrs. Mfg. Northern—*excellent condition.*

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We can save you 40% to 50% of your present net cost on the following 220/440 volt, 60 cycle, 3 phase, 1800 rpm. motors. They are all NEW in ORIGINAL FACTORY CRATES:

Qu.	H.P.	Make	Type	Description
3	25	Ideal	A-365	S. B. open
3	40	L. A.	DGX-404	S. B. drip proof
3	50	Century	SC-405	S. B. drip proof
2	50	Ideal	A-405	S. B. open
4	60	Ideal	AH-444	S. B. open
2	60	L. A.	DGA-444	S. B. drip proof

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P. O. BOX 534 — Tel: Genesee 5629

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COMPLETE STEAM POWER PLANT

1—Babcock & Wilcox Water Tube Boiler:

Type FF-15. Built 1942. 160 lbs. steam working pressure. 310 H.P. or 16,000 lbs. per hour at 100% nominal rating. National Board & A.S.M.E. Standard.

1—E. Keeler Company Water Tube Boiler:

Type "CP" (Self Contained) Built 1942. 160 lbs. steam working pressure. 310 H.P. or 16,000 lbs. per hour at 100% nominal rating. National Board & A.S.M.E. Standard.

Both plants complete with Detroit "Rotostokers" and all necessary auxiliary equipment for automatic coal firing and control. New condition throughout. Can also furnish new Enterprise Rotary type combination gas-heavy oil Burners.

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(6) OIL FIRED B&W BOILERS

Cross Drum Sinuous Headed straight tube type. Heating surface 11417 sq. ft.—1141.7 HP—210 P.S.I.G. design pressure—200 P.S.I.G. working pressure—75,000 lbs./hr. capacity—steam temp., saturated—1024 cu. ft. furnace volume —200° feed water temperature.

(2) B&W WATER TUBE BOILERS

ASME code—from ATR tug—built 1943. 15,000 lbs. steam/hr./unit (normal) 18,000 lbs. steam/hr/unit max. Design pressure—268 lbs/sq. in. —total steam at drum outlet (saturated) 409 —forced draft—turbine driven blowers—1508 sq. ft. boiler heating surface. Gas or oil.

(4) 300 KW G.M. 8-268A DIESEL GEN.

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(2) 60 KW CUMMINS DIESEL GEN.

120/240 volts DC—250 amps.—Model H engine —6 cylinder—heat exchanger cooled.

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.

Heavy duty—totally enclosed—with built-in switchgear. 75 KW — 230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stablized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL

510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

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50 HP—230 volts DC—built in controls—5 ton and 10 ton.

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COMPRESSOR
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A RENTAL COMPRESSOR FOR EVERY JOB

55 CFM Lindsay (GAS) Portable
60 CFM Worthington (GAS) Portable
70 CFM Smith (GAS) Portable
89 CFM 6 x 7 Worthington HB, 15 HP Elec
105 CFM Worth-IR-CPT Portable
107 CFM 7-7 x 7 Ingersoll FS-1 STEAM
129 CFM 7½ x 7 American AF-1, 20 HP
142 CFM Ingersoll Semi-Portable 25 HP
160 CFM IR-Worth Portable
165 CFM Smith 1105R Semi-Portable, 25 HP
195 CFM 8-9 x 9 Worthington HS STEAM
210 CFM Worthington (GAS or DIESEL) Port
211 CFM 9 x 9 Worthington HB, 40 HP Elec
279 CFM 11-10 x 11 Worthington HS STEAM
294 CFM 10 x 12 Worthington HB, 50 HP
315 CFM Worthington (GAS or DIESEL) Port
387 CFM Gardner Semi-Portable, 75 HP
445 CFM Gardner Semi-Portable, 100 HP
462 CFM 12-14½ x 13 American AF-S STEAM
500 CFM Worthington (DIESEL) Portable
538 CFM Worthington Semi-Portable, 100 HP
600 CFM Worthington (DIESEL) Portable
628 CFM 14 x 13 Ingersoll ES-1, 100 HP

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KW.	MFG.	VOLTS	RPM
700	Al.Ch.	480	700
1250	Al.Ch.	480	900
250	C.W.	250	1200

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1000	G.E.	600	1200
4—500	WH.	600	1200

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6—400 KVA GE TRANSFORMERS

Newly Reconditioned 11,800/13,000 volt to 2,300/4,000 volt. Serial Numbers 1632653, 1632652, 1632651, 1645952, 1645953, 1645954.
1 new extra core for above—PRICE $2.00 KVA

2—STARTING COMPENSATORS

1—200 HP—2200V—3 Phase—60 Cy—#1034—K17.
1—250 HP—2200V—3 Phase—60 Cy—#1034—K17. PRICE $2.00 HP

Both F.O.B. Kansas City. Subject prior sale and prompt removal

BROWN-STRAUSS CORPORATION

1546 GUINOTTE Tel. HA-1000 KANSAS CITY 20, MISSOURI

1—2000 KVA, 3-60-23000-4160Y Westinghouse type CPS self-contained substations.
1—450 KVA, 3-60-13200-115/230 V. G.E. substation.
6—Section NEW G.E. switchboard consisting 2000, 600 and 350 A. drawout air breakers.
700 & 450 HP, 180 rpm, 4160V-3-60 UNUSED Syn motors.
1—37½ KVA-240/480 V.-3-60 Cat. Diesel set.

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PRESSURE & STORAGE TANKS
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2—35,000 GAL. 60# W.P. 11'x54'
5—17,300 GAL. 85# W.P. 8'x45'
42,000, 120,000, 240,000 GAL. STORAGE
8—10,000 GAL. RAILROAD CAR TANKS

LESTAN CORP., ROSEMONT, PENNA.

FOR SALE
4—DETROIT ROTOSTOKERS

Practically new, used 1½ years, power dump grates. Complete set of spare parts for stokers and grates, could be used in quads, triple, double or single, capacity 60,000 lbs. per hour.

MICHIGAN CHEMICAL CORPORATION
St. Louis, Michigan

DIESEL GENERATOR SETS

2—875 HP Busch Sulzer. 6 cyl. 300 RPM. 500 KW G.E. 360/240/240 volts.

2—Fairbanks Morse 805 HP — 556 KW; 300 HP — 200 KW. Model 33-E14. 3/60/2400 volts.

Other Makes, Types, Sizes Available

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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STerling 3-6515

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	440	Whse.	1800
600	2200	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
400	440	G. E.	900
300	4000/2300	Whse. (new)	600
300	2200/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
250	440	G. E.	600
200	440/220	Whse.	514
200	440	G. E.	450
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
150	550/220	G. E.	720
145	4000/2300	G. E.	1800
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Mchy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2200/440	G. E.	TS	1200
250	2200/440	G. E.	TS	720
250	440/220	G. E.	ATI	1200
250	2300	G. E.	TS	3600
250	440/220	Whse.	HR	277
250	2200/440	G. E.	TS	1200
250	440/220	G. E.	ATI	600
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
110	440/220	G. E.	TS	257

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200	Whse.	CS	514
500	2200/4000	Elliot	SC	1800
500	2200	G. E.		450
400	2200	G. E.		360
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
250	2200/440	G. E.	IK	720
225 (2)	2200/440	G. E.	KT	1200
200	2200/440	G. E.	K	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
200	2200	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	440/2200	G. E.	IK	514
150	2200/440	G. E.	KT	600
125	440/220	G. E.	KT (vert.)	1200
100	2200/440	G. E.	K	1200
100	220/440	G. E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-pf.	1800
50 (2)	410/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	X-prf.	600/1200

A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 480/220 V., G. E.
1—250—kva. 720 rpm. 2300/440 V., G. E.
1—225 kva. 600 rpm. 220/440 V. G. E.
1—200 kva. 720 rpm. 2200/440 V., G. E. (Ball brg.)
1—187 kva. 1200 rpm. 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E., Sol. oper., draw-out.

D. C. MOTORS

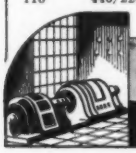
H.P.	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	Whse.	SK	2870
200	230	G. E.	CD	750
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
100	230	Cr. Wh.	CMC	625
90	230	G. E.	CD	1750
80	230	G. E.	RC	600
60	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440/220	Syn.	250
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250
65	G. E.	2200/440	sq. ca.	125
45	G. E.	440/220	sq. ca.	250

TRANSFORMERS 60 Cy.

3—667 kva. Al. Chal., 22000/11000—2300 V.
1—600 kva. Standard, 13.800-2300 V., 3 ph.
3—500 kva, G. E. 22000/11000—2300 V.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G. E., 12000—2300 V.
3—200 kva, G. E. 2300—575 V.
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, G. E., 33000—2300/4600 V.
3—150 kva, Al. Chal., 2400—240/480 V.
3—150 kva, Al. Chal., 2400—240/120 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G. E., 4150—120/240 V.
2—100 kva, Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 50 kva, Whse., 440—220/110 V.
6—50 kva,G. E., 2400—120/240V.



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1250 KVA Westg., 3 ph., 60 cy., 480 volts, 1200 RPM, with 15 KW direct connected Excitor. Late modern steel frame & base unit. Complete with control gear.

125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg.	1200
150	Westg. (3)	900
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
50	Westg. (2)	1150

PLUS 40 additional units ½ to 40 KW

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
750	G. E. (2)	NEW
500	G. E.	500
400	G. E.	NEW
250	Cr. Wh.	1200
200	El. Mchy.	900
150	G. E.	1200
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150
60	N. W.	1150
40	Rel.	1750
40	G. E. 3-Unit	1150
25	G. E.	1200
17	A-C	1750
15	Star	1750
10	G. E.	1150

PLUS 15 additional units ½ to 7½ KW

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- Jenkins Pneumatic Ash Conveying System and 10 Ton Receiver
- Vulcan Soot Blowers (5)
- Cinder Return and Over Fire Air System
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1	150	G.E.	I-M	1200	S. B.
1	125	G.E.	I-M	720	S. B.
1	100	G.E.	I-M	1800	S. B.
1	100	Weat.	CW	1200	S. B.
1	100	West.	CW	900	S. B.
1	100	G.E.	I-M	720	S. B.

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200 HP GE 3-60-2300-164—New
500 HP Allis-Chalmers 3-60-2200-212
900 HP Allis-Chalmers 3-60-2200-180
complete with controls, etc.

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200 HP Allis Chalmers 3-60-2200-440
100 HP Westinghouse 3-60-2200-1200
75 HP General Electric 3-60-440-1800

SQUIRREL CAGE MOTORS

250 HP G.E. 3-60-220-1800
100 HP West. 3-60-2300-1800
100 HP Elec. Mchy. 3-60-440-1200

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3—15D Patterson 24"x116"-125"

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14"x8¾"x10" Sullivan Angle Cpd.
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2500 KVA General Electric 4 stage
200# W.P. condensing—3-60-2300-3600
with exciter, condenser

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35 KW Wauk. 3-60-120/208
50 KW Cat 3-60-220
100 KW Superior 120/240 DC
100 KW Superior 3-60-450

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HOW PRITCHARD'S SINGLE RESPONSIBILITY CONTRACT CAN SAVE YOU MONEY ON POWER PLANT MODERNIZATION

Your choice of Pritchard to provide the modern power installation that meets your requirements gives you more than the exceptional benefits of Pritchard's proved design, engineering and construction skills.

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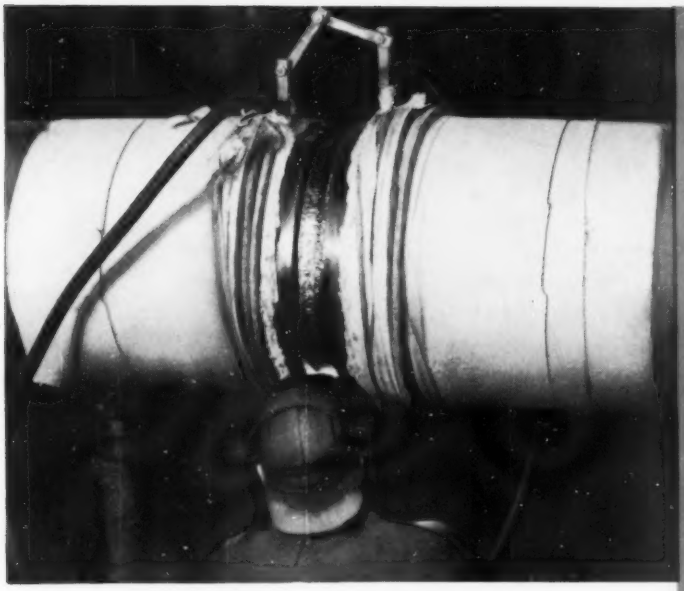


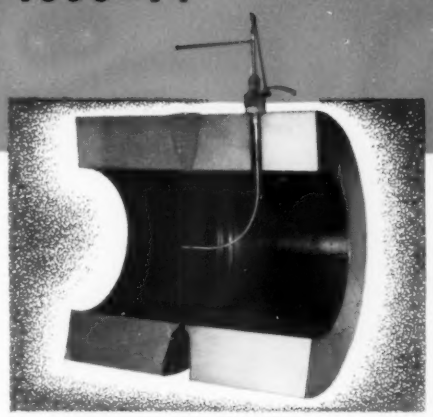
SHOP WELDING 4" WALL PIPE

for steam at 2050 PSI and 1050° F!

You can be confident of the piping fabricated in Grinnell shops, because Grinnell Research predetermines materials and methods, then checks results to insure that specifications are met exactly.

An example of the thoroughness of Grinnell Research is the preparatory work which was done to insure the performance of the piping shown above. This sub-assembly is being fabricated from 4" wall pipe forged from 2¼% chrome, 1% moly steel. To withstand the high pressure and temperature of this installation, Grinnell Research specified the fabricating and welding procedures to be used. This included the time and temperature cycles for preheating and stress relieving, and the correct type of electrodes.

Preliminary test welds on sample pipe were made. These were then cut apart and analyzed to check microstructure and strength of the weld, which had to have the same properties as the pipe itself.



A test piece of 4" wall pipe cut apart to show the quality of the weld. Also illustrated is the method used to introduce a radium capsule into the center of a completed assembly for radiographic examination of the weld.

Taking photomicrograph of specimen of a test weld.

During fabrication, the first inch of each weld was ground smooth and given a complete radiographic examination for possible flaws. Finally the completed weld was checked by radiographic examination.

It's intricate business . . . developing correct fabrication methods for new materials and services. It's one of the jobs for which Grinnell fabrication specialists are well qualified, because Grinnell has the equipment and modern methods, the interpretive engineering, the metallurgical research facilities and the skilled personnel to handle any prefabrication requirement.

GRINNELL

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Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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hotel's Unexpected Guest . . . proves toughness of Carey insulation

Warm, winter rains in the Sierra Nevada brewed trouble for nearby Reno. They washed the snowpack down the Truckee river, which threads through downtown Reno in a narrow channel. In a few hours, floodwaters surged over the river's banks and inundated most of the city's business district.

At Riverside Hotel, one of Reno's finest resorts, this "unexpected guest" kept Carey-insulated steam lines and heating equipment under water four days.

Today, some three years after the flood, the *same* Carey insulation is doing the *same* efficient job of heat conservation at Riverside Hotel. Only hand-moulded valve fittings and canvas covering needed replacement on hot water and steam lines.

As Riverside's chief engineer put it—"considering the damage we expected, and the abuse the insulation got, it held up remarkably well."

While you may never face flood conditions, you will find it pays to standardize on Carey insulation with *proven* toughness and efficiency. The complete Carey line includes high and low temperature blocks and blankets, pipe insulation, pipe jackets, cements—a Super-Light 85% Magnesia in precision-sized blocks and nesting O. D. pipe coverings you can apply easily and cheaply—remove and reapply when necessary. Get the facts today. Contact your Carey Sales Engineer, or write for latest bulletin "Industrial Insulation," Dept. P-11.

- Insulation Contractor: Reece Insulation Co., Los Angeles, California
- Architect: Frank Green, Reno, Nevada
- General Contractor: M. J. Brock & Son, Los Angeles, California
- Heating Contractor: Earl O. Stice, Glendale, California
- Air Conditioning Contractor: Air Conditioning Co. of So. California, Los Angeles, California

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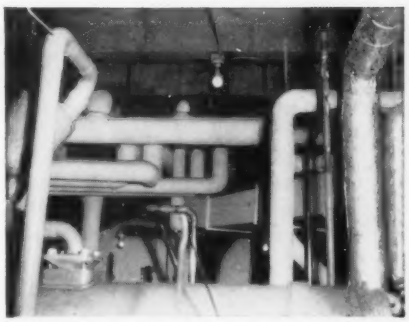

After the flood, canvas covering on Carey insulation was replaced and painted. Fittings for valves were repaired and painted. Shown here are domestic hot water tanks, Freon compressors, steam lines from boilers to hot water heating coils and water lines from deep well pumps for cooling compressors.

Shown here is domestic hot water tank and condensate return pump, main steam line and main steam line shut off valve. Since boilers were returned to operation after the flood, service has been highly satisfactory.

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